DISCOVERY

A MONTHLY POPULAR JOURNAL OF KNOWLEDGE

EDITED BY EDWARD LIVEING, B.A.

SCIENTIFIC ADVISER: A. S. RUSSELL, D.Sc.

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THE "ENDURANCE" SET IN THE ICE
(By courtesy of William Heinemann)

Special Features in this Number:

AT THE BRITISH ASSOCIATION MEETING

THE SHRINE OF THE MOON-GOD

350 MILES ON FLOATING ICE

A TSAR'S EMPTY TOMB

Also Articles and Book Reviews on RECENT RESEARCH AND DISCOVERIES

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JOHN MURRAY, 50A ALBEMARLE STREET, LONDON, W.1.

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DISCOVERY. A Monthly Popular Journal of Knowledge.

Edited by EDWARD LIVEING, B.A., 23 Westminster Mansions, Great Smith Street, London, S.W.1, to whom all Editorial Communications should be addressed. (Dr. A. S. RUSSELL continues to act as Scientific Adviser.)

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Editorial Notes

AN account of the principal addresses at the British Association's Meeting at Liverpool in September appears in this number. This account will, we hope, show the very definite work which scientists are doing in the solution of the thousand and one problems of our modern complex civilisation. It is evident to us that a marked change of feeling has come over the public in their attitude towards scientists during the last year or so. They are beginning to be listened to more seriously and the jokes about them in the press are rapidly vanishing! People are realising that the word "scientist" is not synonymous with an old, hairy, bespectacled professor surrounded by books and bones or fumbling about with evil-smelling liquid concoctions. There is less opposition, too, than there was in Darwin's day between science and religion, and we have recently seen in the press the Dean of St. Paul's patting Mr. Julian Huxley, the well-known young Oxford biologist, on the back for an essay of his on "Science and Religion," albeit be made some errors in interpreting parts of this essay!

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Moreover, many of our modern scientists are adventurers not only in theories or in laboratory work, but in foreign lands and the few remaining unknown regions of the earth, and their deeds in such a rôle cannot fail to appeal to the British psychology. In this number of DISCOVERY Mr. R. W. James writes on the subject of pack-ice, recording carefully and unostentatiously his examinations of the vast ice-floes and their movements in the Antarctic made when he was a member of the *Endurance* expedition. His narrative is purely scientific and, therefore, we cannot publish it without filling up some of the gaps of adventure and peril. The expedition of the *Endurance* commanded by the late Sir Ernest Shackleton performed some of the most astounding feats recorded in the annals of polar exploration. At the time these feats were eclipsed by the world-war, and despite Shackleton's account [1] and the cinematograph records shown subsequently, they are perhaps still sufficiently unknown to merit being described here. After voyaging south from South Georgia, the *Endurance* was beset in the ice on January 18, 1915. The members of the expedition remained on the vessel, which drifted northwards in the vast drifting ice-floes till she was crushed on October 27. They then took to the ice with their tents, boats, and stores, watching their refuge of many months disintegrating till she sank on November 21. Till January 2, 1916, they drifted northwards for 350 miles on an ice-floe, which with the increasing warmth broke up into countless fragments till one night they found themselves on a piece of flat ice 200 ft. long and 100 ft. wide. At last there was sufficient room between the bergs to take to the three boats, which were launched on April 9, 1916, and reached Elephant Island six days later, after some narrow "shaves" with onrushing ice débris.

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This was the first landing ever effected on the island. Shackleton set off in his famous open-boat journey to South Georgia to obtain relief, while twenty-two members of the expedition, including Mr. R. W. James, were left on the island under Commander Wild. There they lived for nearly five months under precarious conditions, sleeping under the two remaining upturned boats and eating seal, penguin meat, limpets, and seaweed till, after various unsuccessful attempts,

[1] *South*, by Sir Ernest Shackleton. (Heinemann.)

Shackleton, in the *Yelcho*, a steel vessel belonging to the Chilian Government, rescued them on August 30, 1916. They were down to their last Bovril ration and had scarcely four days' food in hand; ice-floes were rapidly closing in on the island, and in another few days it might have been necessary, with almost undoubtedly disastrous results, to have postponed the work of rescue till the next year.

* * * * *

Archæological work in the Mediterranean and the Near East is being attended with remarkable results. The finding of Tutankhamon's tomb in Egypt last autumn has been followed this year by the successful excavation of the ancient Chaldean temple of the Moon-god in the sand-covered mounds in Mesopotamia, which mark the site where five thousand years ago flourished the great city of Ur, and by some extremely interesting discoveries made by Sir Arthur Evans at Knossos, in Crete. The recent excavations at Ur are described by Messrs. Hall and Woolley, whose efforts have been largely responsible for their success, in this number of DISCOVERY. Sir Arthur Evans has described the results of his excavations in Crete in articles in *The Times* of August 28 and 29.

* * * * *

Our readers may remember that we reviewed last month an excellent little book on the results of Sir Arthur Evans's and other archæologists' excavations in Crete, and emphasised the fact that our knowledge of the commercial and cultural relations between Egypt and Crete were still very scanty. Crete, we have to bear in mind, was the stepping-stone in the Mediterranean for the ancient Egyptian civilisation that penetrated into Europe through Greece. Any new evidence, therefore, that can be obtained of the relations between Egypt and Crete goes to the reconstruction of a most important page in the history of early civilisation. Sir Arthur Evans's researches in Crete this year have provided a goodly number of bricks for such a reconstruction.

* * * * *

In the first place, he has succeeded in tracing a prehistoric road across the island from Knossos on the north coast to Phaestos on the south coast—a road which he believes formed part of the route used to link Knossos with the Libyan coasts, the remainder of the route being, of course, maritime. Another piece of evidence of trade between Egypt and Crete was revealed in the discovery of an early dynastic porphyry bowl. More remarkable still was the finding of a house of frescoes at Knossos which, in Sir Arthur's words, constituted "a unique illustration of the painter's art as it existed in the Golden Age of Minoan Crete." These frescoes are of an age not later than 1,600 B.C. The scenes in these mural decorations, he says, "are laid amidst rocks with flowering plants or sometimes marine growths; the rocks being vividly veined and banded so as to resemble cut sections of such stones as agate, sardonyx, or malachite. Their outlines show an extraordinary feeling for the 'grotesque' in art, and their borders were at times flung by the artist across the carefully executed and many-banded frames, as if the artist gloried in the defiance of artificial control. . . .

"Besides olive sprays, there are seen impressionist designs of branches bearing what look like egg-shaped plums, red and yellow."

* * * * *

Part of the frescoes show monkeys fairly easily identifiable as of the *Cercopithecus* variety, which were possibly imported by the Minoan priest-kings from the Sudan or were received by them as gifts from the Pharaohs of Egypt. Some small fragments of painted stucco frieze show a picture of a Minoan captain, with his men, whose skin is coal-black. "So the historic secret is out," writes Sir Arthur. "Minos employed negro mercenaries."

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One is tempted to ask whether there is any common cause for the widely separated disasters due to disturbances beneath the earth during the last twelve months. First there came the great tidal wave on the west coast of South America, destroying several seaboard towns; this was followed early this year by earthquakes in Kamchatka, later by the eruption of Etna, the most severe for many years, by volcanic disturbances in the China Sea, and finally the Japanese earthquake, which we believe is the most disastrous in recorded history. There is not yet any agreement as to the cause of earthquakes, in fact it is probable that several causes may be operative on different occasions. Humboldt, the great scientist and traveller, wrote nearly a century ago that in South America there was a constant relationship between earthquake and volcano; he thought that volcanoes were a safety-valve, and noticed that when in a volcanic country eruptions grew less frequent, earthquakes were to be feared. This opinion is at least as old as the ancient Greek and Roman writers, and the researches of Professor John Milne in 1895 showed that in Central Japan, where volcanoes are many, earthquakes are rare, and that by the sea-coast, especially in the east, the reverse is the case. Sometimes great volcanic eruptions and devastating earthquakes occur in close connection; this was the case in Hawaii in 1868. In other cases, however, volcanic eruptions of exceptional severity have taken place without any earthquake, perhaps because the "safety-valve" action has been efficient. It is probable that in many cases where no activity has been

noticed, earthquakes may yet have been caused by eruptions of molten lava which have not reached the surface, since geological evidence shows that these subterranean intrusions do take place.

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The theory that earthquakes are due to the tidal attraction of the moon has been recently revived in several quarters. It is a very old idea, and superficially sounds attractive, especially if the view, now discredited, that the earth consists of a solid crust and a molten centre, is held. It was put on some kind of basis by Alexis Pewey in 1864; he collected a very large number of records of earthquakes, and found that they were more numerous when the moon was nearest to the earth. Since his day, however, a great many more records have been made, and it is certain that there is no relationship between the nearness of the moon and disasters such as that in Tokyo. However, the statistical work done by Pewey has proved invaluable to later workers.

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In a general sense, it is certain that an earthquake is an effort on the part of the surface of the earth to accommodate itself to a stress or strain. Dr. Robert Mullet thought that this strain was caused by the gradual cooling of a heated globe; every now and then the earth cracks like a glass vessel, in his view, since the hard outer crust must accommodate itself to the shrinking core. Other authorities have considered the effect of long ages of redistribution of loads caused by the denudation of mountains by ice and rain, and the consequent instability. Perhaps most earthquakes may be attributed to a cause of this nature. The balance of the earth's surface, which has been upset by ages of denudation and sedimentation, is suddenly restored by what is called a "Tectonic earthquake." Sometimes a deep shelf is caused by the sudden collapse; sometimes the disturbance is beneath the sea. Why earthquakes are more common in one part of the world than another; why volcanoes appear to have a definite relationship in many cases, remain difficult questions to answer. They are perhaps bound up with the problem of the formation of the earth's surface discussed in recent articles in this Journal.[1]

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Articles in our November number will include: *An Imperial Airship Service*, by Major W. T. Blake; *A Working Philosophy of Life*, by Dr. W. Tudor Jones; *The Berber Tribes of Morocco*, by Dr. E. Gurney Salter; and *Arsenic Burning in Devon and Cornwall*, by Edward Cohen.

[1] See DISCOVERY, vol. iii, No. 29: *The Origin of Continents and Oceans*, by Professor Alfred Wegener; vol. iv, No. 43: *The Structure of the Earth—A New Theory*, by O. H. T. Rishbeth (describing Kober's theory).

The Shrine of the Moon-god, and other Recent Discoveries at Ur

By H. R. Hall, D.Litt., and C. L. Woolley, M.A.

THE mounds of Tell el-Muḳayyar, near Naṣirîyeh in Southern 'Iraḳ, which we now know to mark the site of the ancient Ur of the Chaldees, have been noted as a seat of early civilisation ever since the time of the Italian traveller Pietro della Valle, who in 1625 first described the temple-tower which then as now dominated the surrounding mounds like an Egyptian pyramid. Della Valle brought back to Europe some of the inscribed bricks that then as now strewed the site, and was the first to conjecture that the strange marks upon them were ancient writing.

Early Excavations on the Site

The interest of the British Museum in Tell el-Muḳayyar dates from the time when Rawlinson at Baghdad was deciphering the cuneiform script and British influence was powerful in Turkish Asia, so that requests from British travellers and antiquarians to excavate and seek for antiquities met with ready acquiescence. Moved by Rawlinson and the accounts of Mr. Loftus, of the Persian-Turkish boundary commission of 1849, who had excavated at Warka and Susa and visited Muḳayyar, the Trustees of the British Museum in 1854 deputed Mr. J. E. Taylor, H.M. Vice-Consul at Basrah, to excavate at Muḳayyar and at the neighbouring mounds of Shahrein, which cover the ancient city of Eridu. He dug with considerable success at both places and gave us the first intelligible accounts of them, besides sending back interesting antiquities (such as the foundation-cylinders of Nabonidus's restoration of the temple-tower at Ur) which have been in the British Museum since the time of the Crimean War.

Post-war Excavations

The work then lapsed, and was not resumed till the last year of the Great War, when the Trustees determined to take advantage of the British military occupation of 'Iraḳ, and resume archæological operations there. Captain R. Campbell Thompson, late of the British Museum and then on the Intelligence Staff of the Army in Mesopotamia, was commissioned by the Museum authorities to take up this work, and proceeded to Ur and Shahrein in 1918. At Ur he made a short preliminary investigation, then confining his work to Shahrein. Next year (1919) Mr. (then Captain) H. R. Hall, of the British Museum, was sent

out to carry on the work, Captain Thompson having returned home on leave. Mr. Hall also worked at Shahrein, but devoted most of his attention to Ur and a subsidiary mound, about four miles off, known by the names of Tell el-Ma'abed ("Mound of the Place of Worship"), Tell el-'Abd ("Mound of the Slave"), or Tell el-'Obeid; the last name is that most generally used. It was at Tell el-'Obeid that the chief discovery of the expedition of 1919 was made, in the shape of a small L-shaped building of very early "plano-convex" bricks, apart from which, at the south end, was found a cache of copper figures of the early Sumerian period (about 3000 B.C.): lions and small bulls of copper with bitumen within (like the figure of Bel in the Book of Daniel, that was "brass without and clay within"), a copper relief, 8 ft. long, of a lion-headed eagle (the emblem of the city of Lagash) grasping two stags by their tails, a gold bull's-horn, a stone figure (torso) with a very archaic inscription commemorating a certain Kur-lil, keeper of the granary of the city of Erech, a squatting stone figure (complete), probably of the same person and certainly of the same period (Fig. 3); besides various other antiquities, such as pottery, flower-decoration for walls with stone petals fastened by copper wire; all of the same period, and forming an important addition to our knowledge of ancient Sumerian[1] art and to the collection of the British Museum.

At El-'Obeid, as at Shahrein, much was gleaned from the surface of the desert that is undoubtedly of pre-Sumerian age, consisting of stone objects of various kinds, including flakes and celts of obsidian crystal and chert that are considered to belong to the latest Stone Age or the Chalcolithic period, and fragments of the characteristic prehistoric Babylonian pottery, made before the invention of the quick wheel, and decorated not only with geometrical but also with frankly naturalistic designs (not so stylised as at Susa) in black and occasionally in red. This pottery is identical with that found by Pézard at Bushire recently, and is related to that discovered by de Morgan at Susa and Tepe Musyan in Persia and that found by Herzfeld at Samarra in 'Iraḳ. It has been described and illustrated by Thompson in his publication of the work of 1918 at Shahrein in *Archæologia*, vol. lxx, 1920, and by Hall in the *Journal of Egyptian Archæology*, vol. viii, 1922. It is found also at Ur here and there. This style of pottery-decoration of the primitive period is found in Turkestan, at Anau

FIG. 1.—GENERAL VIEW OF *Ê-NUN-MAKH*, UR: 1923.
By courtesy of the British Museum.

[1] The Sumerian civilisation in Mesopotamia is a less known but even earlier civilisation than that of the ancient Egyptians.

to the west and in Baluchistan to the east, and even so far east as Honan in China. It may be related also to the early pottery of the Black Sea region and Thessaly. In Babylonia it would appear to have been abandoned in the Sumerian period for a plain drab ware that persisted till the end.

A Vast Sacred Enclosure

At Ur one of the chief discoveries of 1919 was that of the wall of the sacred enclosure and temenos of the Moon-god, which was identified as such in 1919. The upper part of this wall was then uncovered for a stretch on the east side of the temple tower, at each end of which a great gate was discovered by the explorers of 1923, Messrs. C. L. Woolley, F. G. Newton, and Sidney Smith (of the British Museum). This renewed work of the British Museum was shared in, under the direction of Mr. Woolley, by the University of Pennsylvania (Philadelphia Museum).

In the 1922-3 season, the main work was the tracing of the outlines of the sacred enclosure. This was found to be a rectangle some four hundred yards long by two hundred wide, surrounded by a heavy wall built of unbaked brick which enclosed intramural chambers; its outer and inner walls were each more than three yards thick, the chambers over four yards across, so that the total width of the whole wall was some thirty feet; its exposed faces were decorated with buttresses and with vertical T-shaped grooves in the brickwork. There were apparently six gates (of which only four have been excavated); as a rule, the gateway lay in the centre of a fairly deep recess set back from the wall line; strong towers flanked the entry, which passed through a gate-chamber formed by the two pairs of boldly projecting buttress-jambs and was closed by a wooden door set between the outer jambs; the gate-chamber was roofed with heavy palm-logs overlaid with matting and earth as are the modern houses of the country.

There must have been a sacred enclosure at Ur from the earliest times, but a large number of inscribed clay cones found along the wall line inform us that the wall was built by Ur-Nammu or Ur-Engur, the first king of the Third Dynasty (*c.* 2300 B.C.), who probably enlarged at the same time as he refortified the old enclosure. How much of the surviving work is to be attributed to Ur-Nammu it is hard to say; the wall was patched and even rebuilt by his successors down to the last days of the city, and as all of them employed mud brick, and built in the same style and more or less on the same lines, there is little to distinguish the early brickwork from the later; most of the gates, where the use of inscribed burnt bricks and of inscribed stones as hinges for the doors affords dating evidence, have been entirely rebuilt, and the names encountered in them are those of Nebuchadrezzar, Nabonidus, and Cyrus the Great (559–529 B.C.), so that they date from the last century of the town's existence.

Within this enclosure lay the chief temples of Ur. Towards the eastern corner rose the huge ziggurat,

FIG. 2.—EXCAVATING THE TEMPLE OF THE MOON-GOD AT UR IN 1919.
The *ziggurat*, or temple-tower, in background.
By courtesy of the British Museum.

the staged tower already mentioned above which was the outstanding feature of all Sumerian towns, its bulk dwarfing all the other buildings of the place and dominating the flat alluvial plain around; even to-day its ruins are a landmark visible for many miles. In the south corner there may have been the palace of the king, a site which perhaps still awaits excavation; the rest of the temenos, so far as we can yet judge, was occupied by temples.

Temples and Palaces

In 1919 Mr. Hall discovered and excavated partially to the south-east of the tower a brick building (pro-

visionally known as "B") which at first was supposed, on the evidence of the stamps on bricks of its pavement, to be Ê-ḫarsag, "House of the Mountain," a palace of the King Shulgi or Dungi, the successor of Ur-Nammu. This evidence is apparently contradicted by the discovery in 1923 and identification by

FIG. 3.—SMALL STATUE OF KUR-LIL, DOORKEEPER OF THE TEMPLE OF ERECH; ABOUT 3000 B.C.
Found at el-'Obeid, 1919.
By courtesy of the British Museum.

Mr. Sidney Smith of a brick with the temple-inscription of Ur-Nammu in the wall of the building. It is not yet decided, therefore, whether this building is a palace or a temple, though Mr. F. G. Newton, speaking as an architect, pronounces in favour of a temple and the authority of Ur-Nammu's bricks over Shulgi's! Unluckily a foundation-deposit excavated in 1923 yielded us no decisive evidence on the point, as the tablet accompanying it, which should have told us the name of the builder, was blank.

This building "B," if a temple, was no doubt part of the great temple of Nannar. The part uncovered (Fig. 2) may have been chiefly the priestly quarters. It was later on, after it had long been burnt and ruined, reoccupied and then certainly inhabited (in the Assyrian period probably) by priestly families who rebuilt it on a slighter and smaller scale, generally using the ancient bricks for the purpose. Some of their domestic additions, such as bread-ovens, wash-places, etc., still remain, and the later walls, either of their time or (some) possibly of even later period, are easily distinguished by their slightness and careless building from those of the original builders, which are splendidly built and generally 5 ft. thick. In this building pottery and tablets of the Assyrian period were found in 1919, and a few relics of the original builders, including two fragments of statues (now in the British Museum) of the later Sumerian period, the age of Gudea, whose famous statues are now in the Louvre.

If "B" is part of the temple, then the palace Ê-ḫarsag is to be sought elsewhere, possibly near-by, as has been suggested above. In 1919 a foundation tablet of Ur-Nammu was found loose in rubbish against the south wall of "B," which commemorates the founding of *Ê-makh*, "the Noble House," a temple of the goddess Ninsun. It is not impossible that "B" may eventually turn out to be Ê-makh.

In 1919, and also in 1923, several graves were discovered and excavated. The work of 1919 was purposely directed to the discovery and investigation of as many different types of ancient remains, whether temples or tombs or what not, as possible, in order to obtain an idea of what the site was likely to yield in the future. It was intended to "sample" the site. For this reason a beginning was made with the excavation of the town ruins to the south of the transverse *wady* (small valley), south of the sacred enclosure, which divides the mounds of Ur into two parts. Among the few ruined streets and houses which were investigated were found many pottery coffers or *larnakes* with burials, always of bodies in the crouched position, with a few pots, beads of agate and cornelian and amethyst, and perhaps a silver pin or two. They are of comparatively late date, probably of the Assyrian period. Actual tombs of bricks, built up with a keeled roof over the larnax, were also discovered in another part of the mound, near the ziggurat. Another type of burial was in two large round pots, placed mouth to mouth, with vent-holes at the other ends to enable the gases to escape.

The Shrine of the Moon-god

In the course of last season Mr. Woolley and his associates completely excavated a second temple (Fig. 2), *Ê-nun-makh* or *Ga-nun-makh*, which was dedicated to the Moon-god and his consort. The building stood upon a low platform supported by a brick retaining wall, 9 ft. thick and heavily buttressed. The sanctuary proper was quite small, consisting of five rooms connecting with each other, and was entered by a single rather narrow door. Round the sanctuary ran a corridor, and between this and the platform wall

all the space was occupied by a series of long-service chambers which were used either as store-rooms or for other purposes connected with the temple. Several times in the course of its history Ê-nun-makh had been destroyed, and as often rebuilt from the ground up, and still more often had kings and rulers of Ur patched and repaired the venerable shrine; but all had been careful to adhere to its original ground-plan, using what remained of the old walls as foundations for what had to be built afresh; one or other might make some addition to the temple, increasing its area, but none ventured to alter the type which his predecessors had laid down once and for all. The first royal builder whose name is recorded on the bricks is Ur-Nammu, but the temple had been razed and rebuilt at least three times before he came to the throne in about 2300 B.C.; we have objects dedicated in it by Rimush, who was king of Agade about 2650 B.C., but that date would hardly take us back through more than one period of reconstruction; the walls of *terre pisée* (stamped-down earth) which we found underlying the earliest mud-brick structure may well belong to the fourth millennium before Christ. The Third Dynasty was brought to an inglorious end by an Elamite invasion, when the temple of the Moon-god must have suffered severely; certainly it had to be repaired fairly extensively by the kings of the Larsa Dynasty who in their turn controlled Ur, for we find cones and bricks of Nur-Adad, Arad-Sin, and Rim-Sin. A thoroughgoing reconstruction was undertaken by King Kudur-Mabug, about 2000 B.C., and there are few parts of the existing building where his work cannot be traced.

But the reconstructed building was not destined to endure for very long. Early in the second millennium a fresh disaster overwhelmed the city, and the Moon-god's shrine was destroyed; beneath the pavement of the succeeding period was found a thick stratum composed of the fragments of stone vases, dedicated in the temple by royal worshippers ranging from Rimush to Rim-Sin, which had been wantonly smashed and thrown away—an act of sacrilege which can only have been ventured on by an alien conqueror. Kurigalzu, who reigned about 1600 B.C., was obliged to rebuild È-nun-makh from its foundations. His temple, subject to minor repairs, e.g. by Sin-balatsu-iḳbi, Chaldean governor of Ur under the Assyrian overlord Ashur-bani-pal (669–626 B.C.), lasted for a thousand years; then, about 600 B.C., Nebuchadrezzar not only rebuilt but remodelled it. The King of Babylon respected the ancient sanctuary, but he swept away all the service-chambers that lay in front of its door, and substituted for them two paved courts—a lower and larger court extending across almost the whole width of the original platform, an upper court opening off it and surrounded on three sides by the sanctuary façade and by two new wings that were now built up against the same. Thus the whole character of the place was changed; whereas the sanctuary had been shut away in the midst of its outbuildings, approached only by a winding passage (a sanctuary, it is evident, reserved for a priesthood practising a secret ritual); it now formed the background of an open court where the public could assemble and watch the sacrifice being performed on the upper terrace, and see, beyond the officiating priest, the golden statue of the god inside the shrine,

FIG. 4.—HEADLESS STATUE OF ENTEMENA; ABOUT 3000 B.C.
Found at Ur, 1923.
By courtesy of the British Museum.

set on the base of which, and immediately fronting the door, the foundations still exist. There had been a change from private to public worship such as is hinted at in the story of Nebuchadrezzar and the Three Children in the Book of Daniel. The same arrangement of the temple was observed when Cyrus

the Great in his turn repaired Ê-nun-makh, and it is interesting to see how closely that agrees with the description given by Herodotus of the contemporary temple of Bel at Babylon.

Of particular interest are the broken fragments of dedicated vases which have already been mentioned, for these not only, by their decoration and by the inscriptions on them, throw light on the early art and history of southern Mesopotamia, but they have an important bearing on the vexed question of Egyptian chronology. The whole collection belongs to a period whose limits are 3000 to 2000 B.C., and many of the vases are of Egyptian type and material, in some cases apparently actual importations from the Nile valley, in others close copies of imported originals ; and while the bulk of the types are those of the First Egyptian Dynasty, none are later than the Fifth. So far as it goes, the evidence is all in favour of the " shorter chronology " ; it is to be hoped that further synchronisations may yet be found to settle this much-disputed problem of ancient history.

A Royal Statue 5,000 Years Old

Our most important individual " find " was a headless diorite statue of Entemena, king of Lagash about 2900 B.C. (Fig. 4). The squat figure wears the usual Sumerian robe of sheep's fleece, and bears a long inscription engraved across the back and shoulders. In a deep brick-lined well there were found a number of large clay cones inscribed with the building records of the Larsa kings who reigned towards the end of the second millennium, records which add greatly to our knowledge of the history of the site. Under the Persian floor of Ê-nun-makh was discovered a hoard of jewellery, beads, brooches, pendants, earrings, bracelets, and rings of gold and semi-precious stones, a gold pin with a head in the form of a full-length figure of a priestess, and bronze and silver vessels, all heaped together below the pavement-tiles. A smaller hoard found in another part of the site was of earlier date, probably of the seventh century B.C.

The great temples of the sacred city were repaired for the last time by Cyrus. Not long afterwards, perhaps about 450 B.C., Persian iconoclasts, who made a movement against the use of images in religion, destroyed by fire all these monuments of old idolatry. Ur did not long survive the religion which had been its glory ; a rapidly dwindling remnant of inhabitants squatted on the ruins of the ancient shrines, and probably by the time of the Macedonian conquest the city (333–323 B.C.) was " fallen upon an heap," hardly less desolate than it is to-day.

At present we have recovered only the skeleton of a history which lasted for at least four thousand years, perhaps for twice as long ; further excavations should fill up many gaps in our knowledge and yield something like a continuous record of this, one of the earliest cradles of Man's civilisation. It is to be hoped that the happy co-operation of the British Museum with the Museum of the University of Pennsylvania, inaugurated by the renewed work of 1922–3, will result in the construction of such a record obtained from regularly continued and systematic excavation.

Antarctic Pack-ice and the Fate of the "Endurance"

By R. W. James, M.A.

Senior Lecturer in Physics in the University of Manchester ; Member of the " Endurance " Expedition

SURROUNDING the Antarctic Continent, and extending in many regions hundreds of miles from its shores, is a great belt of floating ice, known usually as the pack-ice, or, more shortly, simply as the " pack." This ice-belt is certainly one of the most considerable of world-phenomena. Formed mainly in high southern latitudes by the freezing of the sea-water, the ice is driven northward by the prevailing winds which flow outwards from the continental ice-cap, while to the south fresh ice is formed to take its place, so that there is, on the whole, a continuous flow of ice northward, carrying polar conditions considerably beyond the true geographical polar regions.

The study of the movements of the polar ice is of great scientific interest, particularly from the meteorological point of view. It is perhaps not too much to hope that, as the circulation of air and ice in the polar regions becomes better known, weather forecasting in the Southern Hemisphere may become much more definite than it is at present. Weather is largely conditioned by air movement, and air movement is due in the first place to temperature differences. Evidently then, a northward flow of ice and cold air from the polar regions on such a vast scale must have enormous influence on the climatic conditions of the whole hemisphere.

Hitherto the pack-ice has been considered mainly as an obstacle to navigation. Such detailed studies as have been made of it have been made by ships frozen in and forced to drift with the ice. Such drifts are irksome and dangerous, and fatal to the full success of an expedition, yet they are not without scientific value. In the Antarctic the drift of the pack-ice has been studied in this way by the *Belgica*,

to the west of Graham Land; by the *Deutschland*, in the Weddell Sea; by the *Endurance* of Sir Ernest Shackleton's 1914 expedition, also in the Weddell Sea, but on a course considerably to the west of that of the *Deutschland*; and by the *Aurora* of the same expedition in the Ross Sea. The ice circulation is thus best known in the Weddell Sea, a great bight extending to nearly 78° south latitude, south of the Atlantic.

James Weddell, who discovered this sea, reached a latitude of 74° 15′ S. in February 1823 with no ice in sight, but otherwise the reputation of the sea for ice is bad. Bruce, who discovered land on the eastern side of the sea in 1904, which he called Coats Land, was prevented by ice from reaching a high southern latitude, and attempts by Larsen and Nordenskjöld to penetrate very far south on the western, or Graham Land, side of the sea were much hampered by heavy pack. In fact, in the south-west part of the sea, land has not yet been sighted. The German expedition under Filchner attained a latitude of 77° 40′ and actually made a landing, but finding no suitable place for winter-quarters, made their way north again, and were caught by the ice in March 1913, and after a drift of eight months, were released in lat. 63° S.

How the "Endurance" was Frozen in

The *Endurance* left South Georgia in December 1914, the intention being to form a base near the land discovered by Filchner. Ice was encountered near the South Sandwich Islands, about lat. 58° S., and the course was set to the east to try to get round the ice, but as it seemed to extend indefinitely in that direction, the ship's head was turned south a few days later. For the next month the ship was forced through the pack, which most of the time was fairly close, and on January 10, 1915, Coats Land was sighted. The ice was thick and heavy off the land, but there was open water along the coast and good progress was made along new land until January 18, when the junction with Filchner's Luitpold Land was nearly reached. Here misfortune befel the *Endurance*. She had to put out some thirty or forty miles from the land in order to get round some heavy pack, and in trying to force a way through a thick belt of ice she was held up, and was unable to move either backwards or forwards. All might yet have been well had not a persistent north-easterly wind set in, which carried down quantities of drift-ice which lay to the north, and packed it closely round the ship. The

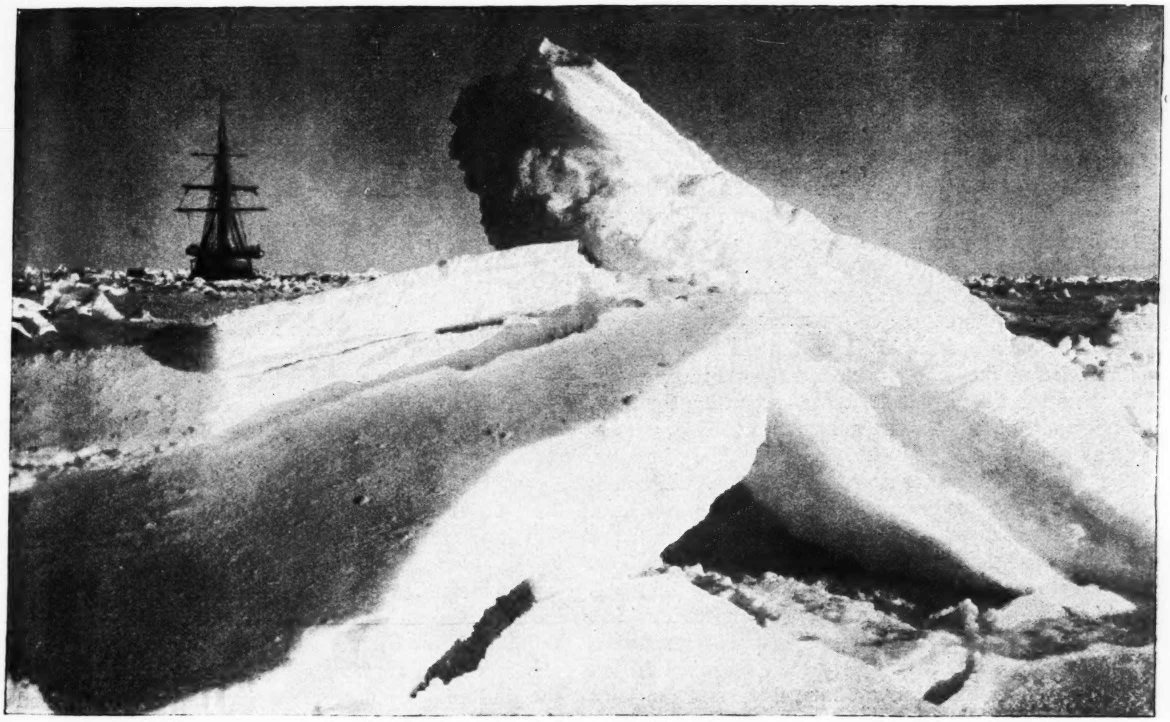

FIG. 1.—THE *ENDURANCE* SET IN THE ICE.
By courtesy of William Heinemann.

temperature fell very low for the time of year, and by the end of February it was plain that the *Endurance* was frozen in for the winter. The ice and its movements and changes now became a most important and interesting matter, since the fate of the party largely depended on what the ice might do, or where it might be taken. Starting with the freezing-in of the ship, let us follow the life-history of the pack as it was observed by the *Endurance* party.

We must consider first of all not an ice-free sea, but one covered with more or less closely packed drift-ice, one, two, or even more years old, much of it very heavy. This ice was often several feet in thickness, deeply snow-covered and ridged up into hummocks. It had been formed, in all probability, at a great distance from its position at that time. In the summer it is not as a rule cold enough to cause any permanent freezing of the water between the heavy floes; they remain separate, and may be likened to the pieces of a gigantic jig-saw puzzle spread over the surface of the sea. The loose floes do, however, tend to keep together in fairly closely packed belts or streams.

Into such a belt the *Endurance* forced her way and was finally held up. Before a change of wind loosened the ice enough to free her again, the next stage in the formation of the winter pack had started; the water between the floes began to freeze, cementing the loose aggregates of smaller floes into much larger ones, many square miles in area. In the middle of such a floe the *Endurance* was now firmly frozen. Attempts had been made to break her loose, and partly as a result of these, partly owing to ice movement, a large pool had been formed in which the ship lay. This was fortunate, as when the pool froze the ship was held in a strong sheet of fairly homogeneous ice. During the winter the ice on this pool reached a thickness of about 5 ft. Very soon the wind drifted the snow over the surface of the floes, and the joins between the older floes were mostly hidden, so that the composite nature of the larger ice-floes could easily be forgotten.

The ridges and hummocks on the surface of the ice act as sails, and the floes drift before the wind. Very large areas are set in motion at once, floes and icebergs move at the same speed, so that the movement can only be detected by astronomical observations. Every day, therefore, when possible, the ship's position was determined. The drift was at first to the west, but in March became more northerly, and it was evident that the ship was in the main circulation of the Weddell Sea ice, and likely at all events to solve certain problems of interest, even although the expedition had failed in its main object. The ice-fields, although very large, do not cover the whole sea in the same way that ice covers a pond, otherwise such movements as those described above would be impossible.

The large floes are, in fact, continually breaking up and joining again, steady motion over a large area seldom being maintained for very long. There are several reasons for this. The original ice-floes from which the aggregates are formed float in equilibrium on the water, which supports them in the most effective way. If a number of such floes are cemented together by new ice, the resulting large floe will still rest in equilibrium; but if, later, the wind drifts the snow about the surface, altering the distribution of weight, equilibrium will no longer be maintained, and considerable tensions may be set up in the ice, which may be large enough to cause it to break. Strains may be set up in a different way. If the ice-field is large, the action of the wind on different parts of it may vary greatly both in force and direction, and once again tensions may be caused with the consequent formation of cracks.

Ice "Ridges" Separating the Floes

For various reasons then, the ice-field is likely to crack. The cracks form very suddenly and may extend for miles; they may remain fairly narrow, or they may open out into large "leads" a mile or more wide. In the winter these newly formed leads freeze over very quickly. In the course of a few days a foot or more of ice will form, and if, in the meantime, there has been no relative movement of the floes, the new ice will be level, although never slippery, and its surface will present a very marked contrast to the older snow-covered floes on either side of it.

Suppose now that relative movement of the ice begins again, owing to a disturbance of the temporary equilibrium, by wind or current, so that the two heavy old floes move together again. The foot-thick ice on the lead will be unable to resist this movement, and will crumple and break, and pile itself up into ridges formed of ice-blocks of all sizes, up to a few feet square, until the old floes are nearly together again. Thus the lead or crack is replaced by a pressure-ridge. This process is always going on and the landscape is always changing. Every large floe is surrounded and separated from its neighbours by a "hedge" of pressure-ridges, and the ice-surface becomes more and more irregular and difficult to march over. The ridges extend of course, to a much greater depth below the water than they do above it. The ice along such a ridge may, perhaps, be 100 ft. thick, although the general thickness of the floe which it borders may be only a few feet. A pressure-ridge is usually a line of weakness. In spite of its immense thickness, the actual contacts of ice-block against ice-block form

only a small fraction of the total surface of separation, and breaking constantly occurs along old pressure-ridges.

The heaviest pressure-ridges are formed by a somewhat different process. Suppose a crack has divided a heavy floe into two pieces, each perhaps several miles square, and that they then move together again. They will rarely come together so that they fit exactly, for there will nearly always be some lateral displacement. Most of the pressure between the two will be taken on a few projecting corners. In addition there may also be a twisting or screwing motion of the ice. If the pressure goes on, a buckling of the floes at the regions of contact will occur. Blocks from one floe will be driven up over the surface of the other, and in this way ridges are formed of blocks perhaps 5 or 6 ft. thick. This process is known as "rafting." Pressure-ridges seldom reach a great height. Thirty feet was very exceptional in the Weddell Sea, and from 10 to 15 ft. above the water-line may perhaps be taken as an average height. The formation of pressure-ridges by screwing and rafting is the greatest danger to which a ship drifting in the pack-ice is exposed. This type of pressure, during the drift of the *Endurance*, became more common towards the end of the winter. It did not as a rule occur during gales, but generally in periods of calm, often shortly before a gale. We may perhaps get an idea of its causes from the following analogy.

Wind Effects on Drifting Pack-ice

Suppose a jig-saw puzzle, emptied out on a smooth table, is pushed along by means of a ruler. This may be taken as representing pack-ice drifting under the influence of a wind. The analogy is not quite accurate, since the wind, when conditions are steady, will act all over the surface of the ice, and not just along the edge of the field; but if we suppose all the pieces of the puzzle to be moving steadily to begin with, this will not matter. Now suppose we move the ruler and apply it in a different direction. This represents a change in the direction of the wind, not taking place simultaneously all over the ice-field, but beginning at one edge of it. After a time all the pieces of the puzzle will get into steady motion in the new direction, but during the change from one motion to the other much relative movement of the pieces will take place. They will rub against one another, and twist round, in fact

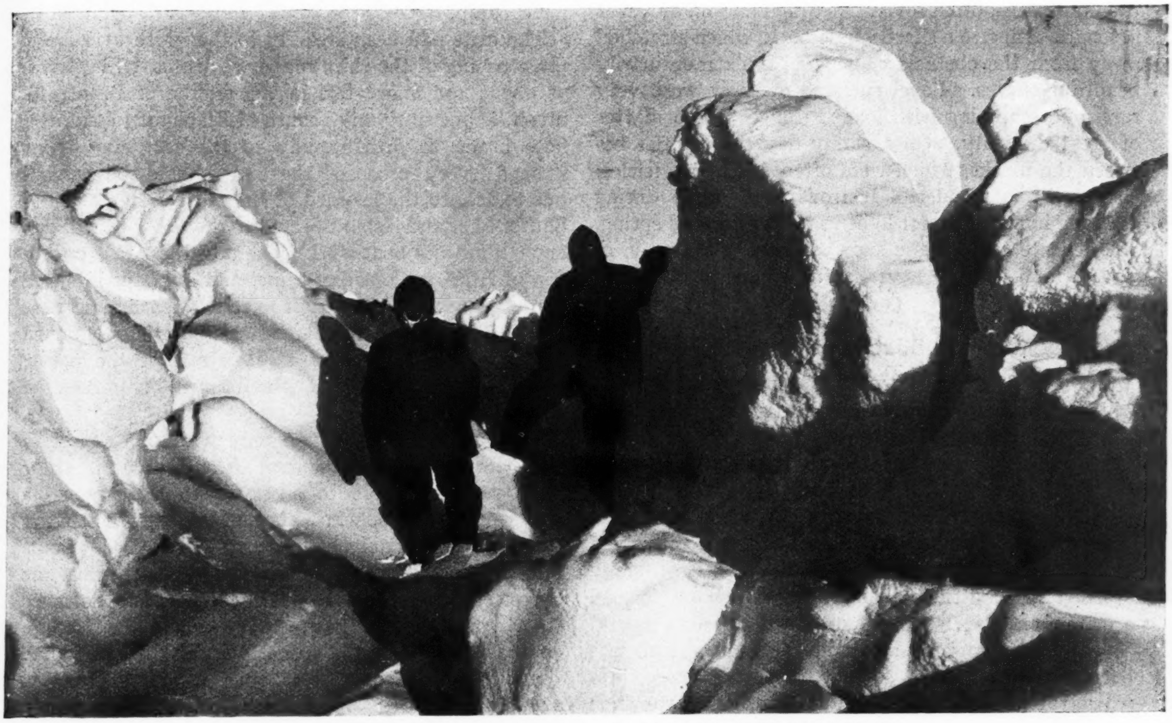

FIG. 2.—SHACKLETON AND WILD STANDING BETWEEN HUMMOCKS OF ICE.

By courtesy of William Heinemann.

there will be a general readjustment of the pieces before steady motion in the new direction is possible.

There seems to be little doubt that readjustment of the floes during change of wind is one of the chief causes of screwing pack and pressure in the open sea.

As a result of the processes described above, the ice surrounding our ship became extremely uneven. Pressure-ridges of all sizes covered the surface, from the newly formed ridge with its blocks square and sharp-cut, to the old ridge of several seasons, with its outlines softened and rounded by the snow.

The wind formed long snowdrifts in the lee of all the hummocks, often several feet high and many yards in length, rising to a sharp whale-back, which stretched away from the obstacle causing it in extraordinarily beautiful curves. Level surfaces of snow were very rare, and marching with loaded sledges was a matter of great difficulty. On a sunny day the cavities between the blocks, which were often filled with icicles, shone with a wonderful lustrous blue, while during the long hours of sunset light in the winter and spring, the delicate tints of the snow surface—pink, grey, or dove-colour—were a never-failing source of delight.

How the "Endurance" was Crushed

But the position of a ship frozen into pack-ice in which constant pressure is going on is very precarious. Towards the end of the winter, when the ice became very lively, it was plain enough that the chances of the *Endurance* escaping unscathed were few. The end came on October 27, 1915, by which time the ship had reached lat. 69° S. She became involved in an area of very bad pressure, and was finally crushed and had to be abandoned. The party formed a camp on the ice and continued to drift north. Summer was approaching, and the temperature was becoming higher again, so that the smaller pieces into which the ice was broken by the disturbances to which it had been subjected did not freeze together again. To this may be attributed the fact that, after the beginning of November, pressure became very uncommon, at all events within the radius of observation from the camp. The ice-floes were probably small enough to accommodate themselves to changes of motion without great pressure.

A Camp on Drifting Ice

But although the floes were no longer frozen together, they still kept too close for us to be able to take to the boats, for the ice was now approaching the projecting hook of the Graham Land Peninsula, and was thus unable to spread out. The drift continued during the summer months of December, January, and February. Seals and penguins, which had been rare during the winter, again appeared in large numbers in the leads, while whales of various kinds were frequent visitors to a large pool which lay near the camp. At the end of March 1916 the ice-floes bearing the tents passed within sight of Joinville Island and continued on their way across Bransfield Strait. Once to the north of Joinville Island the ice began to break up rapidly; it became exposed to a slight swell from the open sea, the large floes cracked parallel to the crests of the swell, twisted round, and cracked again, and soon became uncomfortably small for a camp.

The drift had been steadily to the north ever since the crushing of the ship, for seven degrees of latitude, or about 490 miles, but in the middle of Bransfield Strait, about sixty miles south of Elephant Island, the floes began to drift rapidly to the east, and there seemed every prospect that we should be carried out to sea, to the leeward of the most easterly of the South Shetland Islands, before the ice opened out enough for any boat-work to be possible. But on the 9th of April the opening came, and six days later we made a landing on Elephant Island, whence Sir Ernest Shackleton started on his historic journey to South Georgia, to obtain relief for the rest of the party, which remained on the island until his return on August 30.

This article is concerned only with one aspect of the boat-journey to Elephant Island. During these days we were able to observe the last stages in the decay of the pack. Throughout the drift there had been remarkably little decay of the floes. Some melting had gone on below the water during the warmer months, and the surface snow had softened to a small extent, but on the whole the ice appeared very much the same in April 1916 as it had done in April 1915. But once it was exposed to the action of the ocean swell in Bransfield Strait, the disintegration was astonishingly rapid. The camp floes were already only forty or fifty yards square when the party left them, and during the boat-journey similar floes, packed together in long streams, were passed. On the sides of these streams which were exposed to the open sea, rapid destruction was going on; the ice above the water-line and a foot or so below it was being eaten away, the remaining portions of the floe taking on fantastic forms, some of them of a strange beauty, while the sea was strewn with ice-débris of all kinds.

The ice had been under observation for a period of fifteen months, during which time it had drifted over 1,200 miles; how far it had come before the *Endurance* was caught in it it is impossible to say, but the end of the long journey was now reached.

Why Pack-ice Drifts

Only one other aspect of the drift can be considered here, that of its motive power. This at first sight seems to be simply the wind. When the wind blew the ice moved approximately before it; if it was calm, the ice was nearly always stationary. The most rapid drift was a distance of eighty-four miles in six days, during a strong southerly gale, while for a whole month immediately preceding this gale, during which the winds had been light and variable, hardly a mile had been made to the north. The wind is doubtless the most important cause of the drift, but a more complete examination of the observations than has hitherto been possible will almost certainly bring to light an outstanding effect due to current. The direction of the drift was always a little to the left of the direction of the wind. This is due to the rotation of the earth, and a similar deviation to the right of the wind direction was noticed by Nansen during the drift of the *Fram* across the North Polar Basin. The drifts of both the *Endurance* and the *Deutschland* in the Weddell Sea show strangely parallel courses up to about lat. 65°, when the *Deutschland* took a sudden turn to the east. The average rate of drift of the *Deutschland* was greater than that of the *Endurance*, the latter being more to the west, and presumably closer to land. It is difficult to escape the conclusion that the unknown coast of the Weddell Sea must run nearly parallel to the drift course of these two ships, and the probability of any sea passage from the Weddell Sea out to the Pacific south-west of Graham Land seems small. If such a passage once existed, it is probably now filled up with shelf-ice similar to that of the great Ross Barrier.

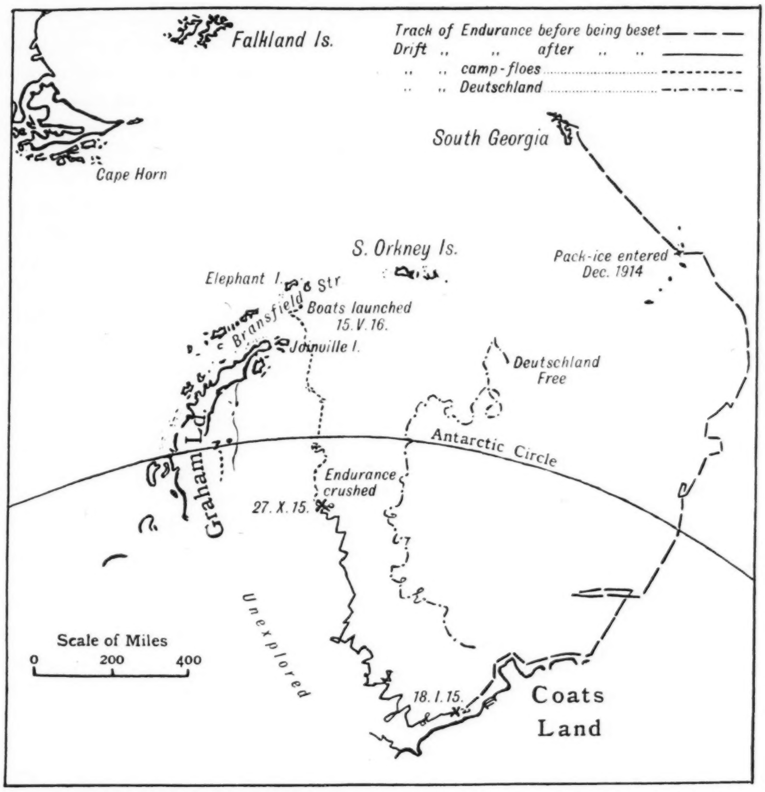

FIG. 3.—MAP OF THE WEDDELL SEA ILLUSTRATING THE DRIFTS OF THE *ENDURANCE* AND THE *DEUTSCHLAND*.

The various problems raised by the drift of the *Endurance* which have been touched on above have been considered very fully by Mr. J. M. Wordie, geologist to the expedition, to whose work reference should be made by those interested in the subject.

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The Empty Tomb of a Russian Emperor

The latest discovery, made in August 1922, concerning the probable end of the Emperor Alexander I (commonly called the Blessed) of Russia.

By Princess E. M. Almedingen, B.A.

THE official date of the death of the Emperor Alexander I, commonly called "The Blessed," [1] of Russia is November 19, 1825, and it is said to have taken place at Taganrog, a small town in the south of Russia.

It was rumoured that the Tzar had died from some infectious disease, and, in consequence of this, the coffin, said to contain his body, was sealed up immediately. Very few of the courtiers were enabled to see the corpse, which was soon afterwards transported to St. Petersburg, and there laid to rest in the usual burial-ground of the Sovereigns of All the Russias—the magnificent Cathedral of SS. Peter and Paul, erected by Peter the Great within the precincts of the famous fortress bearing the same name. However, soon after the Emperor's burial, strange things began to be whispered with regard to the fate of the much-beloved Tzar. People said that he had not died at all, but had just disappeared in order to consecrate the rest of his days to God's service and work and prayer. These rapidly spread rumours, together with the slender evidence which existed even then concerning the authenticity of the body placed in the coffin, gave birth to a series of legends based upon a firm popular belief that the Emperor was still alive and would come back to rule his people once again.

A good reason for these beliefs was naturally suggested by the very character of the Sovereign, a character so strange and weird that it has hardly ever been subjected to analysis by historians. Merejkovsky rightly called him "the mystic on the throne."

The fact that the Emperor's body was seen but by very few people was accepted by the majority as final evidence; and the "Tzar Blagosloweny," or "the Blessed," continued to be alive for his subjects, who, for the most part, considered the rule of his brother, Nicholas I, to be a temporary one only. But all these rumours and easily woven legends had hardly any basis to stand on until they became centred round one mysterious person, living buried in the deep and silent Siberian forests—the famous hermit, "Fedor Kusmitch."

Historically speaking, this hermit's real identity was never proved, and there is now hardly a chance that anything further will come to light with regard to him. The life he led in Siberia was that of a hermit, or, rather, of a recluse. No one knew how he had come there or what he had done in earlier years. That he was a person of importance is sufficiently proved by the fact that the Emperor Nicholas I would often come to him, seeking his advice on many a difficult matter concerning the government of Russia. Many witnesses have stated that the Emperor's attitude to the hermit, as shown on these occasions, was one of profound respect, not to say reverence. The occasional visits of Nicholas I to the strange hermit's cell only served to deepen the mystery. But in spite of the laborious researches of Russian historians, two facts have never been sufficiently proved: first, that Alexander I actually died in 1825 at Taganrog, and, secondly, that the strange Siberian hermit, who lived in his solitary cell for many years, acquiring a very wide reputation for piety and saintliness, was the same person as Alexander I. The legend of Fedor Kusmitch, however, found great favour with the Russians, and many great authors took it as a subject for their writings. First among these authors one should mention Leo Tolstoy and his famous story entitled, *The Legend of Fedor Kusmitch.*

Though historically unproved, the strange legend of an Emperor, giving up his crown and sceptre and all the splendour and glory of court life for the sake of dedicating his life to God in the dark depths of the Siberian forests, in order, as he thought, to expiate his own sins and to plead with God for his country, is quite acceptable to anyone familiar with the Russian soul in general and with the person of Alexander I in particular. The Tzar's spirit grasped the idea of *podvieg*,[2] and all the numerous religious influences under which he had spent his life might very well have led him to a desire to make a great *podvieg* of his life itself. For the present, however, we must be satisfied with the following facts brought to light about one year ago.

In the summer of 1922, during the period of the sequestration of Church plate, a decree was issued by the Petrograd Soviet appointing a Committee of experts for the inspection of all Imperial tombs. It was surmised by the authorities that the Sovereigns might be found buried with their regalia and other gems of great value. This decree was duly executed, and every Imperial tomb was opened and the contents of every coffin duly searched. As could well

[1] The title of "Blessed" was given to Alexander I, after his ultimate victory over Napoleon, by the people of Russia. Napoleon was nothing less than Antichrist in the popular imagination, and the fact that he was conquered by their Tzar brought the Russians to a firm conviction that the Sovereign was endowed with some peculiar graces of God. Hence the origin of the appellation "Blessed."

[2] *Podvieg*—undertaking of some particular work for God's sake; sometimes dedication of one's whole life to God.

be expected, this gruesome search led to very few, if any, practical results,[1] but it made public the not unimportant fact of an Imperial grave being found empty, namely, that of Alexander I.

The coffin was certainly there, just as it was brought in some time in December 1825, carefully sealed up. But when the seals were broken, it was discovered that no body had ever lain there, whilst the heavy weight of the coffin was explained by a few lumps of lead found in it. This discovery destroyed the previous theories that either a dummy lay in the coffin when it was brought from Taganrog to St. Petersburg, and there given the usual funeral with all the pomp and honour due to an Emperor, or else that the coffin did contain a real body, though not that of the Sovereign, who most probably had not died at Taganrog. The magnificent white marble sarcophagus, so splendid in its simple severity, with a single letter "A" in gold letters on the top and a small elaborately carved imperial crown, covered the space of 6 ft. and disclosed nothing but an empty coffin with the original Taganrog seals.

This discovery, naturally, can in no way prove the identity of the person of Alexander I with the strange hermit "Fedor Kusmitch." Yet it does away with the supposition that Alexander's death really took place on that foggy day in November 1825 at Taganrog. And, perhaps, this accidental discovery of an empty tomb within SS. Peter and Paul's walls will give to a future historian of Russia some ground to stand on when he investigates the fate of one of the most mysterious royal characters of the nineteenth century.

Modern Industries—IV

Gem-gathering in Ceylon

By T. Bowyer-Bower, M.Inst.C.E.

Objects of the Industry

Travellers to the Far East have no doubt felt interested in the wonderful display of gems, precious and semi-precious, at Colombo, Ceylon, but probably few have given any thought to the question where these stones have come from or how they were obtained. The average traveller is satisfied if he comes to the conclusion that the majority of stones offered by the dealers have their origin in Birmingham or other places where glass is cheap. As a matter of fact, gems guaranteed by a reputable dealer in Colombo can be relied upon as genuine. For many years the main source of certain precious stones and semi-precious stones that are sold in the European market has been in Ceylon or Burma. There is a very large business done every year, especially with India, in semi-precious stones. Before the war the writer had occasion to investigate the gem industry. The sales of five of the principal dealers showed just on £60,000 profit on their sales alone. As there are hundreds of small dealers and smugglers who rely upon gem-selling as a livelihood, it can be imagined that the business is by no means a small one. The main supply in Ceylon comes from the Ratnapura district of the island, known as the Low Country. The gems are secured by the hand-washing of alluvial deposits, and also in the beds of streams. A gemmer, on finding stones, sells to an agent on the spot. Agents travel the country round, hunting up any new find, and great competition arises as to who the happy purchaser will be. The agent again sells to the dealer and sometimes directly to a foreign purchaser. The dealers also sell, and resell, among themselves. I know of a particularly fine amethyst that at one time or another belonged to every dealer of importance on the island. The last purchaser, despairing of ever selling it at anything like the price he paid for it, had it cut, and to his astonishment he was then able to boast of a very fine profit by selling it to a private purchaser.

It is exceedingly difficult, even to the expert, to give a definite opinion as to how a gem in the rough will cut; and even the gem-cutter may not always cut the gem so as to give the greatest effect of light and colour. A gem of fine quality may be entirely spoiled by being wrongly cut; in the same way one of poor quality may be greatly enhanced in value by good cutting. Fig. 1 shows the gem-cutters in the foreground, and at the back the shadowy figure of the man at the polishing disk. The art in cutting is perhaps more noticeable in the blue zircon, which, to be effective, must be of uniform colour when looked through from every angle of vision. The zircon is one of the least appreciated and yet one of the most beautiful gems, in my opinion. It ranks at the head of second-grade gems, and has the flash and lights of a diamond, and at the same time can be obtained in many beautiful colours and shades.

There is no hard-and-fast method in Ceylon of recovering gems from the earth's surface, such as the custom of recovering rubies in Burma, or diamonds in

[1] Soon after this search had taken place, a rumour was spread among the lower population of Petrograd to the effect that "the Soviet authorities had taken out the body of Peter the Great and were on the point of selling it to some American millionaire," but this rumour was unfounded, and the body of the great Emperor is left to lie in peace in his accustomed place.

South Africa. Every native who owns a small plot is a gemmer. He works at gemming during the dry season when he has little other work to do, and he looks upon gem-recovery as a pastime which is possibly remunerative.

How did the Gems come There ?

The geology of the gem districts of Ceylon is not of a complex nature. The whole island may be taken to be of igneous origin. Granite and gneiss outcrop and protrude everywhere, showing evidence of some huge force that must once have piled the mass of rock to an enormous height, very much higher than the present surface. The gems, no doubt, may have been *in situ* originally, but I have never seen or heard of a gem being found embedded in rock. The only instance which leads one to suppose that the gems were once *in situ* is that garnetiferous granite is found in quantities. On the cooling of the igneous mass, fissures and cracks and the lamination of the rock surface took place, and during the thousands of years of denudation and weathering, hundreds of feet in thickness must have been washed away to the lower valleys and into the huge fissures. The rock-débris became further decomposed and now forms the present surface ; such débris is termed "latterite deposit," and provides the soil that now produces tea and rubber. Where the rock-débris has fallen down to a still lower level it has become a much more decomposed latterite, and is heavily charged with kaoline which no doubt came from decomposition of the felspar in the granite. There are very few gems found in the high elevations—i.e. on the top or steep side of the hills—but a few are found in the beds of mountain streams and natural rock-riffles or depressions. The natural inference would be that the gems, being of greater specific gravity, would have remained more or less near the spot where they were released ; but I am inclined to think that, where a gem was encased in a piece of rock, it was carried away to the lower level, and there washed and rolled about until disintegration took place which released it. Those that were freed at the higher level became encased in the alumina-mud, or clay, or kaoline, which gave the mass sufficient buoyancy to be deposited in the lower gutters. These two processes would explain the fact that gems are seldom found at their spot of origin.

FIG. 1.—CUTTING AND POLISHING GEMS.

Scooping, Washing, Vanning

As we have seen, the lower gem deposits are of a very decomposed nature, being at the present day invariably under water, sometimes at great depth. The gemmer in consequence only works during the dry season, when the water is low, so that he can scoop up the wash with a basket or old pot or a coconut shell ; this is a very tedious and unreliable method, but I have never seen any more modern method used. I saw a case where the gemmer was confident that a very fine gem existed on his plot in about 10 ft. of water, and he dived down with a coconut shell for the precious stone ; he had worked his gem plot on this system, he said, for some years, and still hoped one day to get the gem. The total amount of ground, hand-dredged and brought to surface by this primitive method, was about $1\frac{1}{2}$ tons in three years.

The stream-washing is much more simple and methodical. The stream-bed consists wholly of well water-worn granite, and of boulders and pebbles of gneiss and garnetiferous granite; below the surface-layer the boulders and pebbles are embedded in latterite, much decomposed and with a considerable quantity of kaoline; it is in this that the gems are found. The process of recovery is by washing in a conical-shaped basket made of cane, about 2 ft. in diameter at the top and 12 in. deep to the apex of the cone. A curious feature of these baskets is that they are water-tight. They hold about 30 lb. of wash-gravel: the gravel is placed in the basket, which is then filled with water by submersion; a rotary and at the same time a tilting motion is applied, which causes the lighter particles to come to the surface and pass out over the basket edge. This process is repeated until only a small quantity of the wash-gravel concentrates are left in the cone of the basket. This is then dumped on to a mat and hand-picked for any gems it may contain. All natives in the gem-districts are expert gemmers in their own crude way. The men and boys generally do the digging; the women are certainly the best washers I have ever seen; in fact, they can get a perfect concentrate either by washing with water or by dry-vanning.

In dry-vanning they use a basket made like a housemaid's dusting-pan, and by dexterously throwing up the gravel repeatedly in the air and with a jerk, they pass all material of light specific gravity on to the ground and collect the heavy concentrates at the base of the basket. Impressed with the expertness of the vanning, I made a test of gems from three separate minerals, thorianite, and ordinary gravel. The vanner never lost a single gem or thorianite crystal, and then, to show how expert she was at her job, separated the gems from the thorianite. Fig. 2 shows this woman at work on this actual vanning test.

I have just said that the method of washing gem-deposits is crude. This only applies to the working of the wash-gravel, not in the recovery of the concentrates. The crude methods of working the deposits seem due to the natural laziness of Eastern races. They like better to squat or sit down and scoop up small quantities with a coconut shell than to stand up and use a shovel. Time is no object to them, and gemming is only a pastime to keep them occupied when they have nothing else to do after the rice harvest is in, and it may bring in a few rupees should they be lucky.

The Order of Merit in the Stones

The classification of precious and semi-precious stones varies considerably in the minds of mineralogists or jewellers. The mineralogist classifies according to the chemical composition, crystallisation, hardness, and specific gravity. The jeweller, disregarding these essentials, jumbles them up and classifies them mostly by colour, disregarding the fact that the composition is of the highest importance for value. As the principal demand of gems is for ornamental purposes, it matters very little whether the gem is hard or not, or whether it is in the first or second classification. Effect is the purchaser's object, with the satisfaction of knowing it is not wholly common glass. There is a considerable amount of fraud in the ornamental-stone business,

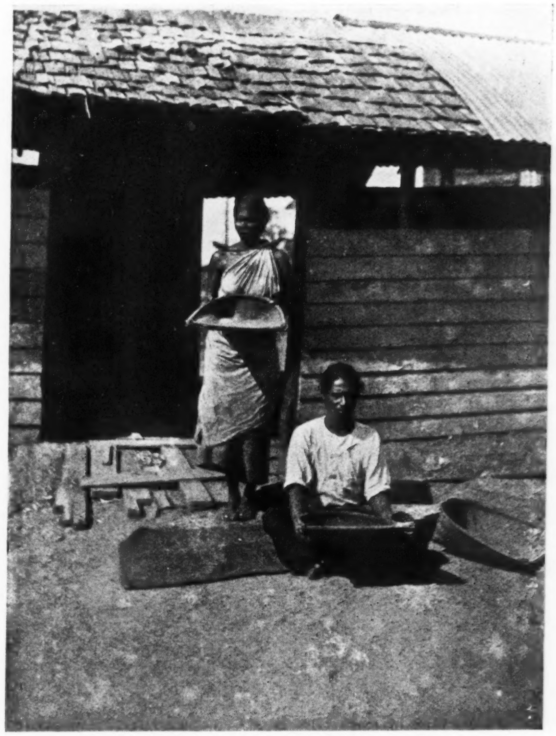


FIG. 2.—A WOMAN SEPARATING GEMS.

since present-day chemists can now construct, from the analysis of real gems, glass substitutes that only an expert can detect. Even sapphires and rubies can be made with all the essentials of the natural stone, i.e. of corundum-construction. In the case of very small stones these reconstructed stones no doubt will pass as genuine, but in the larger specimens there is always to be seen a very minute bubble or air-space which proves their origin. The following classification by Kluge may be of interest; I quote it from *Precious Stones*, by Dr. Max Bauer and L. J. Spencer, M.A.:

A. *Gems of the First Rank*

Hardness between 8 and 10. Consisting of pure carbon or pure alumina, or with alumina predominating. Fine specimens of very rare occurrence and of the highest value.

1. Diamond.	3. Chrysoberyl.
2. Corundum (ruby, sapphire, etc.).	4. Spinel.

B. *Gems of the Second Rank*

Hardness between 7 and 8 (except precious opal). Specific gravity usually over 3. Silica a predominant constituent. In specimens of large size and of fairly frequent occurrence. Value generally less than stones of group A, but perfect specimens are more highly priced than poorer specimens of group A.

5. Zircon.	8. Tourmaline.
6. Beryl (emerald, etc.).	9. Garnet.
7. Topaz.	10. Precious opal.

C. *Gems of the Third Rank*

These are intermediate in character, between the true gems and the semi-precious stones. Hardness between 6 and 7. Specific gravity usually greater than 2·5. With the exception of turquoise, silica is a prominent constituent of all these stones. Value usually not very great, only fine specimens of a few members of the group (cordierite, chrysolite, turquoise) have any considerable value. Specimens worth cutting of comparatively rare occurrence, others fairly frequent.

11. Cordierite.	16. Staurolite.
12. Idocrase.	17. Andalusite.
13. Chrysolite.	18. Chiastolite.
14. Axinite.	19. Epidote.
15. Kyanite.	20. Turquoise.

Where the Machines failed

Fig. 3 shows a small mechanical washing plant in a rubber plantation in Ceylon. This was erected with the idea of testing large deposits. These machines were no doubt very useful for diamond-bearing deposits where there was only a small percentage of heavy particles, viz. diamonds and garnets, but on deposits such as are found in Ceylon they were not a very great success, as they were really too accurate in their work and collected too large a concentrate. The consequence was that the concentrate was too bulky to sort by hand, and ordinary hand-basket washing had to be done so as to reduce the bulk. The same photograph shows the machine in the background, the small native carriers on the right carrying the gravel to the machines, and the native basket-washer in his pit of water, washing, with the basket in the foreground. It was not an uncommon occurrence to obtain half a bucketful ($1\frac{1}{2}$ gallons) of dallam (imperfect gems and crystals of all kinds) per working-day. This when sorted would give probably

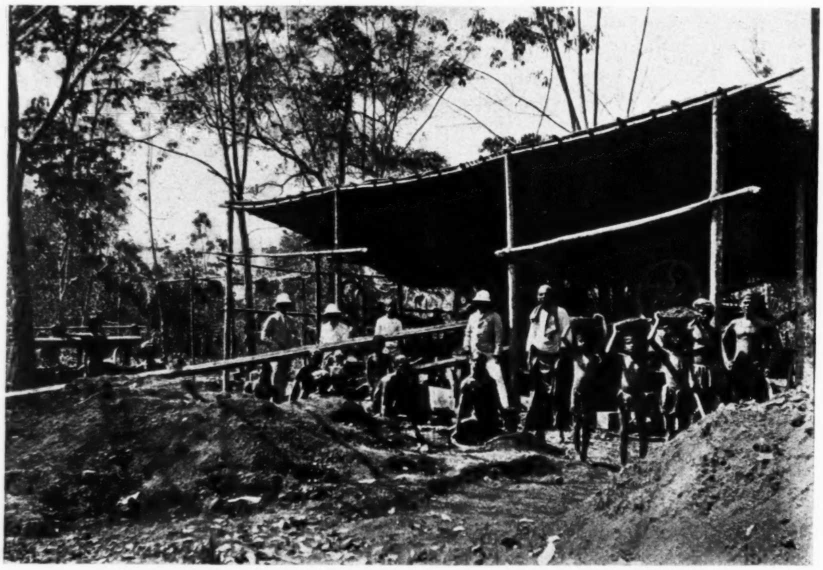


FIG. 3.—MECHANICAL WASHING PLANT IN A RUBBER PLANTATION.

one or two good specimens (generally sapphires), $\frac{1}{2}$ to 1 lb. of corundum crystals good enough for cheaper ornaments or for crushing down for cutting-powder, and the balance a mass of pretty glistening stones useful for cheap ornaments. It is a question why the public prefer glass ornaments when they could get a real crystal from the residues of gem-washings. The cutting of gems is not such an expensive operation as most people think. A very few shillings will cut the stones of average size to be ready for mounting.

Water-work

As in all granite-formations, there is an abundance of water. This has been the prime power that has re-

leased the gems from their original bed and distributed them far and wide over the undulating or flat ground. There are very many beautiful spots in the gemming districts still quite undisturbed by the tourist. I obtained a very fine specimen of Ceylon ruby in one stream a little lower down from a fall, during my course of inspection, but the Ceylon ruby is not counted of first quality as it is pale in colour; the public prefers the pigeon-blood colour of the Burma ruby.

The most valued stones in Ceylon are the sapphires and zircons of deep blue, and yellow to pure water-white, topaz, amethysts, cats'-eyes, star-rubies and star-sapphires, alexandrites, olivines, and the like.

Wanted—Mineralogists

From the view of the mineralogist, Ceylon offers perhaps the best hunting-ground. It has received little or no attention from the mineral financier and comparatively few men of mineral knowledge have troubled about it. There are miles of streams and square miles of deposits that have only been partially scratched by the native. There is still plenty of scope for anyone interested in gems to go and fill his pockets with many beautiful stones, and, if luck comes his way, of obtaining something really beautiful and valuable for his holiday.

At the British Association's Meeting

THE meeting of this famous association, which has come to be looked on in the light of a national institution, was held this year at Liverpool from September 12 to September 19. It was, perhaps, one of the most interesting meetings ever held, since the place chosen is not only one of the greatest ports in the world, but is also an important centre of industry and the seat of a university, and this fact appears to have influenced many of the speeches and discussions. We regret that the meeting was held too late this year for us to include anything like a full account of it in this number. We shall give our readers further accounts of the work got through by certain of the groups in subsequent numbers of DISCOVERY. Meanwhile a short summary will not be out of place.

The Electrical Structure of Matter

The characteristic note of the meeting was sounded on the first day by Sir Ernest Rutherford, this year's President, who in the early stages of his speech on the above subject commented on the benefits of the union of pure and applied science. "If the fundamental researches of the workers in pure science supply the foundations on which the applications are surely built, the successful practical application in turn quickens and extends the interest of the investigator in the fundamental problem, while the development of new methods and appliances required for technical purposes often provides the investigator with means of attacking still more difficult questions."

Passing on to the main thesis of his address, Sir Ernest summarised with wonderful lucidity and comprehensiveness the advances made in man's knowledge of the structure of matter since the last Liverpool meeting twenty-seven years ago. The atomic theory was first announced by Dalton. Next the researches of Lord Kelvin and others resulted in rough estimates of the "absolute dimensions and mass of the atoms," which made scientists realise the minute size of the atom and which led some of them to believe that the atomic theory could never be proved by direct experiment.

Up to this point only vague ideas were held as to the possible structure of the atoms, but there was a general belief that they "could not be regarded as simple unconnected units." In 1897, however, the discovery of what is now called the electron, "a mobile electrified unit," infinitely more minute than the lightest atom, and of the fact that it could be freed from all the atoms of matter by various methods, strengthened the belief, started by Mendeleef's studies of the periodic variations of the properties of the elements, that it was probably the common unit in the structure of atoms. Scientists now began to attack tentatively on these lines the absorbing problem of what the atom consisted of, the work of Sir J. J. Thomson, who boldly took the view that it must be "an electrical structure, held together by electrical forces," contributing greatly to the development of this subject.

Meanwhile the study of radio-activity and the discovery of radium revolutionised "our whole conception of the atom and of the magnitude of the forces which held it together." The extraordinary radio-active elements, such as radium and uranium, enable scientists to study the changes originating actually in the heart of their radio-active atoms—changes which are due to atomic explosions of power infinitely greater than that to be found in ordinary physical or chemical processes. For instance, the so-called α-particle expelled in the majority of these explosions has now been proved to be a charged helium atom, and this has revealed "the importance of helium as one of the units in the structure of the radio-active atoms, and probably also in that of the atoms of most of the elements."

These extraordinary bodies, then, have provided us with much new knowledge of matter and also with tools for further exploration, as in the case of α-particles, which, used as projectiles to bombard and explore the atom's interior, have "exhibited its nuclear structure," and "led to artificial disentegration of certain light atoms."

The detection of the effect of a single atom was first

illustrated by Sir William Crookes in the case of these α-particles which produced flashes of light in a dark room when they fell on a screen coated with crystals of zinc sulphide. Other and more recent methods of detecting and counting individual particles electrically and photographically were described by Sir Ernest Rutherford, notably that of Mr. C. T. R. Wilson for observing the track through a gas not only of an α-particle, but also of other types of penetrating radiations.

Passing on to the various methods of fixing the mass of a single atom and the number of atoms in any given quantity of matter, Sir Ernest mentioned in particular that devised by Millikan, depending "on comparing the pull of an electric field (*i.e. an area charged with electricity and therefore magnetic*) on a charged droplet of oil or mercury with the weight of the drop." This method with the aid of electrochemical data gives wonderfully accurate results, and Sir Ernest considered it to be one of the most notable experimental achievements "in an era of great advances."

The President went on to deal with the idea of the atomic nature of electricity and its connection with the problem of the structure of the atom, giving the evidence for the belief that the atoms of matter are built up of two electrical units, the electron and the hydrogen nucleus—a belief which may be described superficially with a fair degree of accuracy as showing that matter is really a sort of solidified electricity.

Next he returned to the question of the detailed structure of the atom, covering far too wide and technical fields of physics and chemistry for so short a summary as this—Geiger's and Marsden's study of the scattering of α-particles, the work of Laue, the Braggs, Moseley, and Chadwick, and the application by Bohr of Planck's Quantum Theory to the problem of the electronic structure of the atom. Very roughly speaking, the modern conception of the atom reached through these researches is of a minute nucleus surrounded by a swirling group of electrons, differing greatly in number and movements according as to whether the type of atom is light or heavy. An analogy, not to be pressed too far, is that of likening the nucleus atom to a "solar system where the sun corresponds to the nucleus and the planets to the electrons."

A survey of that "comparatively unexplored territory," the nucleus of the atom, followed, including Sir Ernest's and Dr. Chadwick's experiments, Soddy's and Aston's work on isotopes, and researches into the formation and disintegration of atomic nuclei (which also give rise to various interesting theories as to the heat of the stars and stellar evolution, and to the conservation and liberation of energy within the universe).

We must here leave Sir Ernest's survey "of this great period of advance in physical science"—a survey, the value and importance of which, linking up as it does into a homogeneous whole the vastly complicated and widely divergent work of a large number of physicists and chemists, and that puts a completely new interpretation on the structure of matter throughout the universe, can be but little realised from this fragmentary outline.

Science and Transport

Sir Henry Fowler's address to the Engineering Section followed an interesting discussion on the preceding day between the members of his section and the psychologists on *Vocational Tests for Engineering Trades*, and in commenting on the practical application of our vast store of scientific knowledge to engineering he emphasised in his address the "great need for men with the education, the capacity, and the imagination necessary to use this scientific knowledge for the advancement of our profession." Most difficult of all to instil is "that imagination which allows one to see the way in which the knowledge available can be applied in a practical way."

Transport and its Indebtedness to Science is a big subject to cover. "The transportation which aids civilisation is that which cuts down the wastage of power to a minimum and which reduces the time occupied in carrying this out," was Sir Henry's able definition. Taking also the definition in the *Encyclopædia Britannica* of Science as "ordered knowledge of natural phenomena and of the relations between them," he went on to show how in this way transportation has been dependent upon it.

He surveyed the methods of artificial propulsion from the time that Jonathan Halls tried to use a steam engine in a boat on the River Avon in Worcestershire (1736–7) to the present day—the early steam engines and their evolution, the turbine, railway electrification, the internal combustion engine, modern ocean and air transport. On the subject of early railways he recalled a story about Stephenson showing the quickness with which he could apply a known principle to a different object—a faculty which in this case invented the steam whistle.

"On the Leicester and Swannington Railway, which followed the Liverpool and Manchester, one of the Newcastle locomotive drivers—R. Weatherburn—at a level crossing ran into the cart belonging to an old lady, destroying her eggs and butter. Upon his return to Leicester, and reporting this to Stephenson, he was at once told to go down the town to a trumpet-maker and get him to make a trumpet which could be blown by steam."

Among other matters Sir Henry considered at some length the evolution in the materials employed for transport machinery and engines, alloy steels, light alloys, and the work of himself and his colleagues, which has been exceedingly successful in prolonging the life of the railway locomotive crank axle.

Education of the People

After the thoughtless gibberish and "hot-air" of politicians and other second-rate intellects on the question of education, Professor Nunn's speech on the above subject came like a refreshing breeze. He stated the steadily growing belief that "every member of society has an equal title to the privileges of citizenship; and, secondly, that the corporate strength of society should be exerted to secure for him actual as well as theoretical possession of his title."

Education, he considered, should aim at enabling a man

to realise the " fullness " of life. Less attention should be paid in education to what has become almost the sole idea during the decades following Darwin's teachings which looked upon all biological phenomena " as incidents in a perpetual struggle wherein the prizes to be won or lost were the survival of the individual and the continuance of his species." That idea—the doctrine of " efficiency "—should be put in its right place and not raised above the equally needed teaching of the " creative " activities.

Taking the " emergent " view of life and nature, Professor Nunn advocated the need for bringing up our children as good Europeans, but also for shaping them into " that particular brand of good Europeans who are rightly to be called good Englishmen." English letters, English traditions in the arts and crafts, a revival of the old English dances, should form part of the budding Englishman's education. This would not, of course, exclude foreign traditions and art.

Insufficient space precludes a fuller précis of Professor Nunn's many interesting remarks. We particularly liked his definition of a school as a " place where a child, with his endowment of sensibilities and powers, comes to be moulded by the traditions that have greatest significance in the life of to-day," and the way in which he polished off the fears existing in the minds of some persons, that a liberal education will make people unwilling to work, by a quotation from one of Dr. Johnson's sayings : " While learning to read and write is a distinction, the few who have that distinction may be the less inclined to work ; but when everybody learns to read and write it is no longer a distinction. A man who has a laced waistcoat is too fine a man to work ; but if everybody had laced waistcoats, we should have people working in laced waistcoats."

Some Aspects of the Present Position of Botany

In contrast to the majority of the presidential addresses was Mr. Tansley's account of recent tendencies in botanical research, for its appeal was intentionally directed to specialists in this branch of botany and it bore little on the wider problems of science. Botanical research has become divided into a good many branches, one of the two chief stems, the older, being concerned with morphology (the study of the form of plants), and the more recent with physiology (the study of the normal functions and phenomena of plants). Mr. Tansley urged that danger lay in the professional workers in botany specialising so greatly in one branch that they took little heed of another, and advocated closer co-operation between all branches both in teaching and in study.

Other Addresses and Discussions

Among the other addresses Dr. Vaughan Cornish's review of *The Position and Opportunity of the British Empire*, Mr. Julian Huxley's paper on *The Physiology of Development in the Frog*, Professor Elliot Smith's lecture on *The Study of Man*, Professor Newbury's address on *Egypt as a Field for Anthropological Research*, and Sir W. H. Beveridge's speech on *Unemployment and Population*, attracted great interest.

The discussion between members of the Geographical and Anthropological sections on *The Methods of Anthropology in Relation to the Social Sciences* provoked some lively speeches, as also that between members of the Economic Science and Psychology sections on *Psychological Assumptions underlying Economic Theory*.

E. L.

Among the Stars

A Monthly Commentary

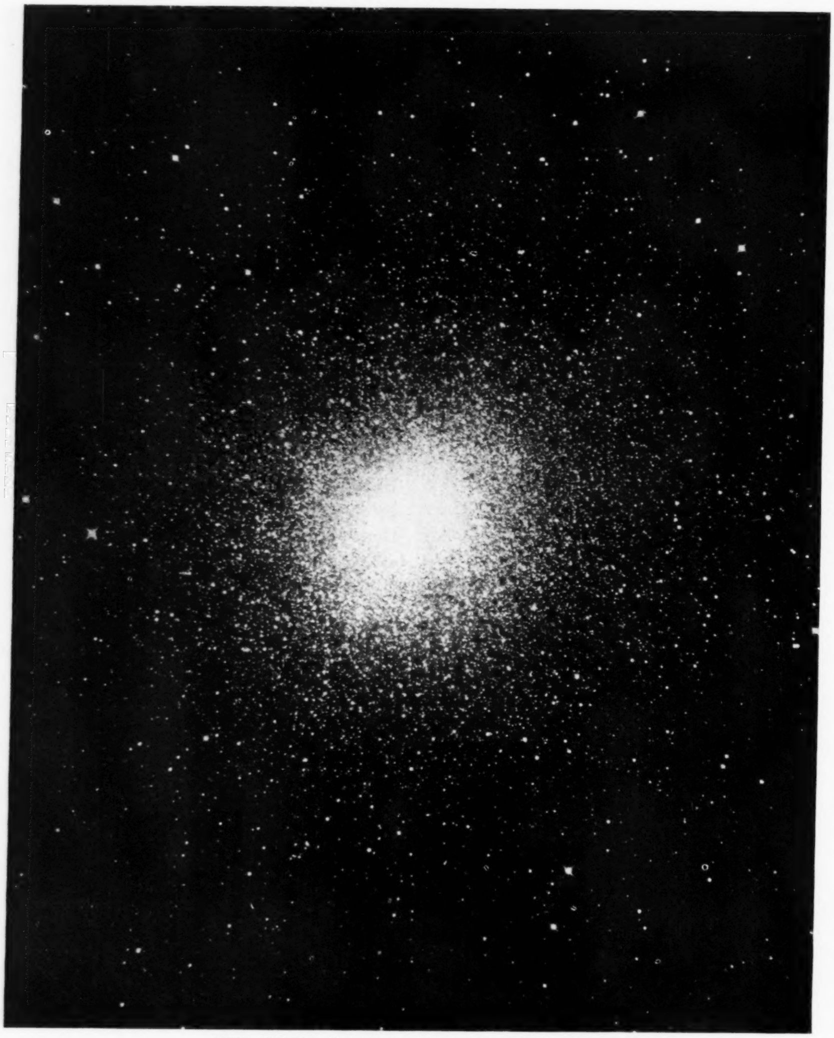
The Distances of Star-clusters and the Scale of the Universe

As is well known, Professor Harlow Shapley's important conclusions concerning the extent of the stellar universe are in great measure dependent on the reliability of the distances of globular clusters which he has deduced by various methods. Fundamental to Dr. Shapley's scale of distances is the assumption that the brightest stars observed in star-clusters are comparable in absolute brightness—or intense luminosity—with the giant stars in the part of the stellar system comparatively close to the Sun, and that the Cepheid and cluster-type variables —stars which undergo changes in brightness visible in star-clusters—are likewise giant stars. This assumption has been questioned by Dr. Curtis, the American astronomer, and more recently the late Professor Kapteyn and Dr. Van Rhijn have urged that the Cepheids in clusters are probably dwarfs. The two Dutch astronomers argued that the large proper motions—i.e. real motions independent of the apparent motion caused by the Earth's changes of position—of certain cluster-type variables in the stellar system indicate large parallaxes and low luminosities. Hence they concluded that the cluster-type variables in clusters are dwarfs, and that Dr. Shapley's distances for the globular clusters are eight times too large. Thus the great cluster in Hercules, according to Dr. Shapley, is 36,000 light-years [1] distant ; while on the scale adopted by Kapteyn and Van Rhijn, the distance is reduced to 4,500 light-years.

In a recent *Circular* issued from Harvard College Observatory, Professor Shapley discusses the crucial question raised by Kapteyn and Van Rhijn. Does the large proper motion of fourteen faint Cepheids of the cluster type indicate that they are comparatively near, and therefore of low luminosity, or are the space velocities of these stars actually high ? Dr. Shapley points out that several of these variables have large radial velocities, that is to say, are moving rapidly in the line of sight to or from our system ; and this fact alone affords strong evidence that these stars have great absolute velocities in space. In the case of the variable RR Lyræ, Mr. Van Maanen has measured its parallax as well as its

[1] A " light-year " is the distance travelled by light in a year. It travels 186,000 miles in one second.

proper motions and has shown that it is of great intrinsic brightness and travelling very rapidly. Dr. Shapley accordingly reaches the conclusion that "the cluster variables of the galactic system appear to have such abnormally high velocities in space that the method of computing mean distances used by Kapteyn and Van Rhijn is of low weight." The average velocity of these stars, Dr. Shapley states, is comparable with the average velocity of globular clusters. "This may indicate that many of the cluster variables of the galaxy were originally members of the same extra-galactic cluster or cloud." In a recent paper Dr. R. E. Wilson discusses the proper motions of seventy Cepheid variables. From a study of the known radial velocities of a few, Dr. Wilson deduces the velocity of the Sun relative to these stars, and from their average peculiar motion he computes the mean parallaxes. The computed distances are in close agreement with the figures reached by Dr. Shapley. Dr. Wilson's investigation is therefore of considerable significance, and his results are strongly confirmatory of Dr. Shapley's estimate of the scale of the stellar system.



THE GREAT CLUSTER (M 13) IN HERCULES.

A Near Stellar Neighbour

The spectroscopic parallax of the fifth-magnitude star Epsilon Indi has been determined at Harvard. The distance deduced from this measurement is seven lihgt-years. If confirmatory results are obtained, it will be safe to conclude that this small star is one of our nearest stellar neighbours. Recent research has shown that in the region near to the Sun, and probably throughout the stellar system, the dwarf stars considerably outnumber the giants.

A New Theory of the Origin of Mercury

Dr. A. C. D. Crommelin has recently drawn attention to a remarkable theory concerning the origin of the planet Mercury, which, he holds, seems "to explain a good many points that are otherwise puzzling." According to this suggestion, Mercury was originally a satellite of Venus. The Earth and Venus are so nearly alike in size that it is not unlikely that they originally rotated at about the same rate. The solar tides, which according to Darwin's theory brought about the disruption of the Earth and the birth of the Moon, would be still more potent on Venus, and it would not be surprising if a considerably larger satellite were born. This huge satellite would very quickly recede from the planet from which it was torn, and in the case of a planet revolving so near the Sun as Venus, the satellite would be likely to escape from the control of the planet and would become a planet on its own account. Dr. Crommelin remarks that the long rotation period of Mercury tends to support this tentative hypothesis, and the fact that the albedoes—or degrees of whiteness—of the Moon and Mercury are nearly the same suggests that they may have had a similar history. The speculation is a daring one, but it must be confessed that it is rather attractive.

Professor Hale's Retirement

There will be widespread and genuine regret all over the scientific world at the announcement of the retirement of Dr. George E. Hale from the post of director of the Mount Wilson Observatory on grounds of ill-health. Dr. Hale will continue as honorary director, but the duties of the office will be discharged by Dr. W. S. Adams, who becomes the second director of the famous institution. Dr. Hale is a comparatively young man so far as astronomers go. Born in 1868, he came into prominence at the age of twenty-four through his invention of the spectroheliograph. At the early age of twenty-seven he was appointed director of the Yerkes Observatory, and in 1905 he was transferred to the mountain observatory on Mount Wilson, with the foundation of which he was closely associated. His researches at Mount Wilson have been chiefly in solar astronomy, in which department he has done enduring work. But no less valuable has been his work in directing the activities of an institution which has been largely responsible for the vast widening of the scientific horizon during the twentieth century.

HECTOR MACPHERSON.

Reviews of Books

PLANT-LIFE IN THE DISTANT PAST

Studies in Fossil Botany. By DUKINFIELD H. SCOTT, LL.D., F.R.S., etc. Vol. II, Spermophyta. Third Edition. (21*s.*)

This volume, which deals with seed-bearing plants, has been in part rewritten; knowledge has advanced and views have changed. It is mainly concerned with the higher types of vegetation preserved in association with our coal seams, and the author contents himself with a comparatively short account of some of the more important genera discovered in strata younger than those of the Palæozoic era. The flowering plants, the dominant class of Spermophyta at the present time, do not come within the scope of the book. This selective method of treatment has its advantages: the student is introduced to a phase of evolution about which we have acquired in recent years abundant information; he is not bewildered by descriptions of obscure, problematical fossils which tell us little that is botanically interesting.

Dr. Scott's researches into the structure of Palæozoic plants have not only thrown a flood of light upon the wonderful vegetation of the remote past, but they have largely contributed to the recognition of the fact that students of botany cannot afford to neglect types that have long ceased to exist if they are interested in the problems of evolution. His work is conspicuously scientific in the best sense; he combines sound scholarship with caution, and he has the ability to make a difficult subject clear to readers whose knowledge of botany is comparatively slight. The book is hardly an elementary treatise; it is an admirable, critical review of the present state of our knowledge of those sections of the plant kingdom chosen for special treatment. A particularly valuable chapter is that on General Results, in which the author summarises all the available information on the older vascular plants. The more we know of the floras of the past, the more difficult becomes the problem of evolution. A superficial acquaintance with extinct types of vegetation may lead to the conclusion that the records of the rocks clearly support the orthodox conception of a progressive development from the simple to the complex, but when we become familiar with the extraordinary complexity and astounding variety of types illustrated by the plants which formed the forests of the Coal Period, and contrast them with their nearest living relatives, we wonder more and more whether it will ever be possible to construct a satisfactory history of the vegetable kingdom from the fragmentary documents within our reach. "In our complete ignorance, now realised, of the methods of Evolution, we cannot hope for very definite success in tracing its course. A more tentative and diffident tone seems to be demanded in discussing phylogenetic problems, and may be found, it is hoped, in the present issue of this book."

The second volume, like the first, is well illustrated and provided with adequate references to literature. The types dealt with in the "Studies" are not merely interesting as examples of structural complexity and of the high stage of development represented by members of the older floras; they are striking illustrations of the uniformity through the ages of the main features of plant-mechanism revealed by the almost perfect sections of petrified stems, leaves, and seeds preserved in the later Palæozoic rocks. We can not only reconstruct the framework of the plant-machine, but we can use our knowledge of the physiology of modern plants as a guide to the conditions under which the vegetation of remote ages had its being.

In the concluding chapter the author deals briefly with the question of the relation of the flowering plants to the older Cycadean types known as the Bennettitales; he favours an affinity between these two groups. While it would be rash to deny the possibility of any real relationship, the opinion may be expressed that no evidence has so far been presented which enables us to understand the evolution of the flower. The tendency to connect group with group is now much less apparent than formerly. Evolution has operated along many different lines, and it is not improbable that the history of the now dominant flowering plants has had but little connection with that of the group which to a large extent occupied the corresponding position in the later Triassic, the Jurassic, and early Cretaceous periods.

A. C. SEWARD.

A NEW INTERPRETATION OF DREAMS

Conflict and Dream. By W. H. R. RIVERS, Lit.D., F.R.S., etc. (Kegan Paul, 12*s.* 6*d.*)

When Professor Freud first enunciated his psychology of dreams, he laid down certain very definite principles which were claimed to be applicable without exception to all dreams, whether of children or of adults, of normal or of neuropathic individuals; but to many of the workers who entered the new field that had been opened up it seemed, as more varied psychological data were obtained, that the original "pioneer" theories were too rigid, and various attempts were made to expand them. Freud himself, largely as a result of a study of the war neuroses, made several important modifications in his theories, and these were recently published in his monograph, *Psycho-analysis and the Psychology of the Ego.*

The late Dr. Rivers, working upon his own dreams and those of patients suffering from war neuroses, came to the conclusion that all dreams could not be explained as the symbolic fulfilment of a repressed wish (as Freud had originally claimed), but might express any emotional state and might be regarded in general as an attempted solution of a conflict, either conscious or unconscious.

Dr. Rivers totally rejects Freud's theory that the form of the dream is determined by a psychological process (the "censorship") which allows the disturbing thoughts which would wake the sleeper to appear only in the disguised and undisturbing form of the dream, and, instead, he holds that the form of the dream is to be explained solely by the fact that in sleep we revert to a more primitive mode of thought, of which the dream is the natural and dramatic expression. The conception of regression during sleep, which was originally emphasised by Freud, is expanded by Dr. Rivers into the attractive theory that the more deeply we sleep the farther we recede from our waking and familiar self and the more primitive and distorted become our dreams. This theory is the corollary of the conception of "psychological levels" formulated by the author in his book *Instinct and the Unconscious.*

Dr. Rivers's early death, that has caused so great a loss to English psychology, left the present work unfinished, and it is almost certain that he would have considerably altered and modified the latter part of it. As it stands, it is of the highest interest to the specialist and a valuable commentary for the general reader who is acquainted with the Freudian theories, but may perhaps have remained unaware of any alternative explanation of the phenomena with which they deal.

F. A. HAMPTON.

BOOKS ON SCIENCE

Metals and Metallic Compounds. By ULICK R. EVANS, M.A. Four Volumes. (Edward Arnold & Co., 21*s.*, 18*s.*, 14*s.*, and 18*s.*, respectively.)

This is a comprehensive work on the chemistry and the physical chemistry of those elements which are usually regarded as metals. It is not so detailed as the many-volume treatises of Newton Friend and Mellor, and differs from these works not only by its omission of an account of the non-metallic elements, but also by its emphasis on metallurgy and on such subdivisions of physics and chemistry as pertain to that subject. The first volume, which no doubt caused the author most trouble, and which is very good, deals with general chemistry, the study of the metallic state, electro-chemistry, the corrosion of metals, and radio-activity. Volume II deals with the metals of the "A" Group, Volume III with the transition elements, and Volume IV with the metals of the "B" Group. The space devoted to each metal is divided into three main sections. The first gives an academic description of the metal and its compounds and contains a summary of the methods of analysis. The second section deals shortly with the terrestrial occurrence of the metal in question, starting with its origin in the rock-magma, and discussing the probable mode of formation of the chief ores and minerals. The third and longest section is of a technical character. The author starts with the ore, follows the metal through the processes of concentration and smelting, and finally considers the practical uses of the element, its alloys and its compounds, trying throughout to make this section a correct survey of industry carried on at the present time.

A book like this one, written obviously to be of use to readers and not to placate imagined critics, which avoids going into the history of every detail as large treatises tend to do, and which gives sufficient references to the literature and sufficient credit to the more prominent workers without surrounding the facts in a sea of proper names, will of course find an audience. It should be useful to advanced students of inorganic and metallurgical chemistry, to engineering and industrial chemists, and indeed to all students of the book's subject-matter who have not the works of Dr. Mellor or Dr. Newton Friend. The chief criticism I have against the book is that it contains matter which is not only irrelevant to the author's subject, but which is better described elsewhere. The sections in the introductory chapter dealing with analytical chemistry, with radiation and chemical equilibria might well have been omitted. And what has radio-activity, well though it is summarised, or the fractiona-

tion of the rare earths, to do with the subject? For the best books, even the best textbooks, are written when the author writes what he knows about and from his own angle, and withstands the desire to say a few words on everything theoretically embraced by his subject. Mr. Evans has done a great work in producing this useful work single-handed, but a critic must affirm that he need not have taken four volumes to say his say.

Atomic Structure and Spectral Lines. By ARNOLD SOMMERFELD. Translated from the third German edition by Henry L. Brose, M.A. (Methuen & Co., Ltd., 24*s.*)

This work of the professor of theoretical physics at Munich is the standard book on atomic structure in use on the Continent, and contains an accurate and singularly luminous account of the subject up to the year 1922. It is for the advanced student only; indeed, "quite a lot of algebra" is necessary for its finer points to be understood. All students of physics and of physical chemistry are indebted to the translator and to the publisher for this book in its English dress. Its place is already with the great monographs on Physics which in our day include Rutherford's *Radio-active Substances*, the Braggs' *X-rays and Crystal Structure*, Bohr's *Theory of Spectra and Atomic Constitution*, and Aston's *Isotopes*.

Stories of Scientific Discoveries. By D. B. HAMMOND. (Cambridge University Press, 6*s.*)

Mrs. Hammond gives in this excellent book short accounts of ten scientists of the front rank and their work. The book has been carefully compiled from the original biographies and is most interestingly written. It is pleasant to have an account of scientific workers which is not marred by untempered enthusiasm, or by the irrelevancies and inaccuracies of the hack writer. The book, in addition, is beautifully printed and the illustrations are good. The authoress has chosen her subjects from different branches of natural science, and selected those lives which are interesting both on the human and on the scientific side. The subjects chosen are Priestley, Lavoisier, and the chemical revolution; Count Rumford; Herschel and the discovery of the planet Uranus; Jean Fabre; Faraday and his electrical discoveries; the Curies and the discovery of radium; Darwin, Wallace, and the theory of evolution; and finally Pasteur and his work on germs and inoculation. The book is heartily recommended to our readers.

Light and Colour. By R. A. HOUSTOUN, M.A., D.Sc. (Longmans, Green & Co., 7*s.* 6*d.*)

This book deals in a popular manner with those aspects of light and colour which the author, a distinguished worker in the subject of Optics, has found to appeal most to the man in the street. It contains chapters on the spectrum, the nature of light, invisible rays, the structure of atoms and of stars, the primary colours, colour-blindness, colour photography, the light of the future, photochemistry, phototherapy, and the psychology of colour. I do not know any book of a popular or a semi-popular kind, published since Sylvanus Thompson's *Light Visible and Invisible*, that covers the ground so thoroughly or that will so well meet the needs of those interested in light as this one.

Dr. Houstoun has an advantage over many writers of books of knowing his subject inside and outside, up and down, and he has succeeded in writing not only accurately and with interest, but with a good deal of humour. And though he is evidently very familiar with the literature of the past, from which he makes several pertinent quotations, his standpoint is, of course, the modern one. He has not much to say for journalists who "explain Einstein." He thinks the soundest attitude with regard to that scientist's theory is to "wait and see." "While Einstein's formulæ are mathematically accurate, it is no disparagement of his great work to suggest that he has not correctly interpreted them. Christopher Columbus died under the impression that it was a new route to the East Indies he had discovered, not America." . . . "Some of the authors who wish to upset Fresnel's work in order to explain the new deflection . . . have about as much sense of proportion as the man who would burn down the house to boil his tea-kettle."

The chapters on colour-blindness, on the light of the future, and on the psychology of colour will be found most interesting by the general reader.

The Discovery of the Nature of Air and of its Changes during Breathing. By CLARA M. TAYLOR, M.A. (G. Bell & Sons, 1*s.* 6*d.*)

This is the second of the Classics of Scientific Method, of which Dr. Singer's *The Circulation of the Blood* was the first. We may apply to the second what was said of the first, "authentic, well written and well produced," and add "wonderful value for the money." This one, by the Head Mistress of the Northampton School for Girls, contains a history of the knowledge of respiration from the time of Harvey (1578–1667) to the time of Lavoisier (1743–1794), and contains a description of the views and experiments of these men and of van Helmont, Robert Boyle, Lower, Mayow, Hales, Stahl, Joseph Black, and Priestley. It is suitably illustrated. This book is heartily recommended to all readers interested in the history of science.

The Structure of the Atom. By E. N. DA COSTA ANDRADE, D.Sc., Ph.D. (G. Bell & Sons, 16*s.*)

Dr. Andrade was in Sir Ernest Rutherford's laboratory in Manchester in the years before the war, and was consequently in touch with the workers whose experiments and ideas led to the theory of the structure of the atom now widely accepted. He has done advanced students of physics a service in selecting the important facts and theories, and in setting them forth in a clear and accurate manner that shows throughout independent thinking and judgment. This book and Sommerfeld's translation noticed above are at present the only all-embracing works on this subject in English. Dr. Andrade's book is more suitable for a first reading of the subject, for it does not treat details in so extended a manner as Sommerfeld,

and it brings the chronicle down to a more recent date. The great contribution of radio-activity and experimental work in connection therewith to our knowledge of the atom receives here its due share of importance, and altogether it is a satisfactory and well-balanced compilation.

Textile Chemistry: An Introduction to the Chemistry of the Cotton Industry. By F. J. COOPER. (Methuen & Co., Ltd., 10*s.* 6*d.*)

The first twelve chapters of this book describe the elements of chemistry, and contain a large number of diagrams exceedingly well drawn by the author. The last six chapters describe the application of chemistry to textiles. It should be found very useful for the students for whom it has been written. The first part of the book would serve as an introduction to chemistry which is anything but bookish for young students.

A. S. RUSSELL.

The Outline of Science. Edited by PROFESSOR J. ARTHUR THOMSON. Volume II. (George Newnes, Ltd.)

The second volume of the *Outline of Science* is fully worthy of its predecessor. It covers a great variety of matter, but it teems with interest in every page. There is rather more physical science and less biological science in this volume that in Volume I, but all the chapters are well worth reading. One may single out specially that by Sir E. Ray Lankester on Bacteria. It is the most complete and scientific account of any of the groups which are dealt with. It is written with all Sir Ray's grasp of the subject, and the historical introduction is masterly. It would be worth while reprinting as a small tract.

Another signed article is that by Mr. Julian Huxley. He has taken an extremely difficult subject and has treated it in due proportion. But the subject is too large for some twenty pages, and one feels that the article is dealing with regions beyond the grasp of the average intelligent non-specialist.

The chapters on applied science, dealing with Electricity, Wireless Telegraphy, Telephony, and Flying, are adequate and are far better illustrated than many of the biological articles. The figures, in fact, throughout the book are very unequal. Some of the reproductions of photographs do not do justice to the originals.

The book closes with a chapter on the science of thought by the editor, and one need hardly say that it is original and stimulating. On the whole we are not at all surprised to learn that the American edition of this work is selling by some tens of thousands.

A. E. SHIPLEY.

MISCELLANEOUS BOOKS

Chanties in Greek and Latin. By W. H. D. ROUSE. (Oxford: Basil Blackwell, 2*s.* 6*d.*)

In this book the Head Master of the Perse School, Cambridge, offers a collection of songs "which the children of ancient days might have sung," and he has fitted them to various traditional tunes. A few of them, such as "The Swallow Song" and "Torty Tortoise," have been adapted from ancient material; others—free translations, paraphrases, and songs which have originated in the author's own head—have been done into Greek and Latin from the English, German, French, etc., originals. Altogether a very delightful collection, which should prove most useful in teaching the two ancient languages in schools through dance and song, and which anyone with a fair knowledge of the classics will easily understand and enjoy.

Dreams of an Astronomer. By CAMILLE FLAMMARION. Translated from the French by E. E. Fournier d'Albe. (T. Fisher Unwin, Ltd., 10*s.* 6*d.*)

An imaginative astronomer's voyage through space which, despite its picturesqueness, imparts much interesting knowledge to the average reader of the realms of space and their occupants.

The Wheelwright's Shop. By GEORGE STURT ("GEORGE BOURNE"). (Cambridge University Press, 12*s.* 6*d.*)

The well-known author of *The Bettesworth Book* and *Memoirs of a Surrey Labourer* gives a comprehensive picture of the trade that was his own livelihood and that of some of his companions during the thirty-six years that he plied it.

Flying Round the World. By MAJOR W. T. BLAKE.

Major Blake is sufficiently well known to our readers to need no introduction. In this book his attempt to fly round the world in 1922 is graphically described, and illustrated with interesting snapshots. Major Blake had to retire from the flight in India owing to appendicitis. The final disaster, described by Captain Macmillan, in which he and Mr. Malins nearly lost their lives in the Bay of Bengal, holding on to their sinking plane for three days and nights, reads like an exciting story in a magazine, but is obviously unexaggerated in every detail. Nearly 11,000 miles were covered in the flight.

Books Received

(Mention in this column does not preclude a review.)

MISCELLANEOUS

Bibliography of English Language and Literature. By A. C. PAUES. (Bowes & Bowes, Cambridge, 6*s.*)

The Travels of Fa-hsien (399–414 A.D.). Re-translated by PROF. H. A. GILES, M.A. (Cambridge University Press, 5*s.*)

Ancient Man. By HENDRIK WILLIAM VAN LOON. (Harrap, 5*s.*)

SCIENCE

Pitman's Radio Year Book, 1923. (Sir Isaac Pitman & Sons, Ltd., 1*s.* 6*d.*)

Wireless World and Radio Review. (Wireless Press, Ltd., 4*d.*)

Fabric of Thought. By G. E. M. ENNIS. (Effingham Wilson, 6*s.*)

Handbook of Physiology. By W. D. HALLIBURTON, M.D., etc. (John Murray, 21*s.*)

The Vault of Heaven. By SIR RICHARD GREGORY. (Methuen, 6*s.*)

A Manual of Histology. By V. H. MOTTRAM. (Methuen & Co., Ltd., 14*s.*)

A Manual of Practical Dactylography. By DR. HENRY FAULDS. (The *Police Review* Publishing Co., 2*s.*)

The Cause of the Rotation of the Earth, Planets, etc. By SAMUEL SHIELDS. (Sir Isaac Pitman & Sons, Ltd.)

Science and Civilization. Essays arranged and edited by F. S. MARVIN. (Humphrey Milford, Oxford University Press, 12*s.* 6*d.*)

The New Natural History. The Twenty-fifth Robert Boyle Lecture. By PROF. J. ARTHUR THOMSON, M.A., LL.D., University of Aberdeen. (Humphrey Milford, Oxford University Press, 1*s.*)

Correspondence

GERM TOXINS AND ANTITOXINS

To the Editor of DISCOVERY

SIR,

Perhaps you will permit me to call attention to a rather remarkable statement in the article *From the Vague to the Concrete*, by Professor D. Fraser Harris, in your July number.

On page 187 Professor Harris writes: " It was soon isolated in pure cultures [the *Bacillus pestis*], grown in artificial media, and its toxins and antitoxins became chemical entities."

Such a statement may easily mislead the uninformed into thinking that germ toxins and antitoxins (or some of them) have been isolated, that they can be weighed and measured like other " chemical entities." This is certainly not the case. If they exist at all they must be definite chemical bodies, yet they cannot be isolated. Their formulæ are not known, they respond to no chemical reagent, and no system of chemical analysis can demonstrate their presence, either in the living body or in culture. They are quite as imaginary and unreal as phlogiston, and like phlogiston there is not the slightest probability of their ever passing from the vague to the concrete.

A little farther on Professor Harris declares that " in 1892 the bacteriologist Pfeiffer isolated the organism of influenza." How does this square with the fact that the organism of influenza is still being sought for ?

Altogether the germ-theory of disease seems to be built on wild assumption. Hypothesis is piled on hypothesis in the effort to make theory fit the facts, just as epicycle was added to epicycle in the effort to make the geocentric theory fit the facts of astronomy. Germs are just as likely to be a consequence as a cause of disease, and quite certainly their toxins and antitoxins have never been proved to exist.

Trusting you will afford space for this letter,

Yours, etc.,

J. CAMPBELL.

10 FAUCONBERG ROAD,
LONDON, W.4.

[Our correspondent, in entertaining a philosophical doubt as to the truth of the germ-theory of the origin of certain diseases, has taken up a position which we find a little difficult to understand. There is not space here for a full discussion of the great mass of knowledge on the subject, which is fully discussed in such admirable textbooks as Muir and Ritchie's *Bacteriology*. The three facts—that a certain bacterium is found in the organs of an animal suffering from a definite disease, that this bacterium can be grown on an artificial medium, and that on injection into a healthy animal the disease is again recognised, together with the fact that this animal develops certain recognisable peculiarities in its blood which are associated with immunity from further attacks in many cases—provide a basis for the theory difficult indeed to undermine.

It is true that the chemical analysis of the poisonous substances, known as toxins, which a bacterium manufactures, has so far proved impossible. But these toxins behave exactly like other well-recognised poisons such as "ricin." It is only very recently that many of the complicated substances which are connected with the processes of life have been analysed and expressed in chemical formulæ ; " Biochemistry " is in its infancy. A poison, however, is none the less a chemical entity because we are ignorant of the arrangement of its elements ; we know well enough what those elements are. So far from agreeing that " there is not the slightest probability of their ever passing from the vague to the concrete," we believe that such a happy consummation becomes each day more probable, and that, when we know their chemical formulæ and can manufacture antitoxins at our will, a very great advance will have been made in the treatment of disease.

As regards the organism of influenza, there is, admittedly, some discussion. This is not unnatural when we remember that the disease itself is far from easy to recognise, save in epidemics when great numbers of individuals present the same symptoms. Some recent work has gone to show that a " filter-passer " is associated with influenza ; but at present Pfeiffer's bacterium has not definitely been ousted from its position of dishonour.—ED.]

DEATH-IMPULSES

To the Editor of DISCOVERY

SIR,

As a result of holidays I have obtained my July number of DISCOVERY over a month late, so I have only just read Mr. Hampton's review of Professor Freud's *Beyond the Pleasure Principle*—a review with which I disagree so strongly that I would be grateful for space in your correspondence columns to put forward another view of this book

The argument of the book is simple. A man dreams fearful dreams in which he goes over an unpleasant past experience, a child sometimes throws away his toys. These are the only two empirical facts on which this theory of death-instincts is based. The theory is not

based on a logical argument from these facts. Roughly it is this: the known facts *a* and *b* can be classed together under the name X. Since the class X exists, the hypothetical facts *c*, *d*, etc., of the class X must also exist. This is not a caricature of Freud's argument; it is his argument. Since the two facts mentioned above can be observed and may be called *repetition-compulsions*, therefore other repetition-compulsions must exist; in fact the impulse to the reinstatement of the inorganic condition must be inherent in the living organism. Now this is not a logical conclusion, it is a simple fallacy, the old fallacy of giving to a name more reality than is contained in the observed facts which the name originally covered. Freud points to no actually observed death-impulses. He makes a tentative suggestion that sadism may be such an impulse, but realises that all his previous work has made of sadism an impulse of the opposite kind, one belonging to libido or the life-impulses.

Your reviewer speaks of "the conclusions to which an unflinching intellectual courage may lead him" (Freud). But these are not conclusions at all, in any ordinary sense. They are not reached by any process of logical reasoning, but are more closely related to "free-associations"—the polar opposite of logical thinking.

Professor Freud is, I believe, one of the most talented original observers of our time, but I do not think that his permanent reputation will be advanced by those who would take as serious contributions to science these latest fanciful imaginings. Even in his best work there was a tendency to alogical thinking which went side by side with careful observation and cautious generalisation. It was this tendency which has made it so difficult for his work to be appreciated at its true value by more logical thinkers. In his latest work this alogical tendency seems to have taken the bit between its teeth.

It seems better to take this book at Freud's own estimate as "the exploitation of an idea to see how far it will lead," and to regret, perhaps, that so brilliant an investigator prefers such diversions to the task of adding to the body of scientific knowledge.

Yours, etc.,
ROBERT H. THOULESS.

THE UNIVERSITY,
MANCHESTER.
August 15, 1923.

ATLANTIS

To the Editor of DISCOVERY

SIR,

With reference to the Editorial Notes in the August issue, may I be permitted to criticise your usage of the word "Atlantis"? You employ it to denote (i) a submerged continent in the Pacific, and (ii) an ideal civilisation; whereas, as you are doubtless aware, the original Atlantis of Plato's legend was an island continent in the Atlantic, which, subsequent to the decay of the quasi-ideal civilisation upon it, was submerged by a tremendous cataclysm.

That "Atlantean" civilisation was a mythical ideal, similar to that of the "New Atlantis" of Bacon, is no doubt true, though "Utopian" would, I suggest, convey that meaning more precisely; but the use of the word "Atlantis" in connection with a submerged Pacific land-mass is to be deprecated.

In Plato's story—as also in the various deluge legends—we probably have, in spite of the much-vaunted Celestial Myth theory, an actual reminiscence of a land submergence coeval with prehistoric man, taking place, as the etymology of the word "Atlantis" suggests, somewhere in the Atlantic region. The various attempted identifications of the submerged area—e.g. with the Dolphin Ridge, with the Palæolithic land-bridge between Great Britain and the European continent (Dogger Bank), etc.—are, at the present time, largely discountenanced; but, at any rate until research definitely demonstrates the entire falsity of the legend, it would be a pity for the original significance of "Atlantis" to become obscured by using the name, even allegorically, in connection with *any* submerged land-mass, irrespective of location in time and space.

In particular, to associate the submergence of a civilised (albeit possibly mythical) Atlantic continent with the breaking up of the Pacific Ocean portion of Gondwana Land, the latter event taking place during the Mesozoic era, ages before the earliest traces of Anthropoids had appeared, is surely scarcely justifiable.

Yours, etc.,
STANLEY A. MUMFORD.

RUNNYMEDE,
11 WELLINGTON ROAD,
ENFIELD.
August 8, 1923.

[It must have been obvious that the notes in question were dealing with two different subjects, connected together to preserve an allegorical continuity. Roughly speaking, in the first six paragraphs we mentioned the geological and other scientific evidence as to the existence of Gondwana Land, which we said "stretched from Brazil to Australia, even including a vast portion, if not the whole, of Africa in its extent" (i.e. occupying considerable portions of what are now known as the Atlantic and Pacific Oceans), which we were surely entitled to consider as our "lost Atlantis"; we also commented in those paragraphs on forthcoming investigations of the Pacific portion of this "lost Atlantis." In the remainder of the notes we passed on to a consideration of the purely ideal Utopias formulated in men's minds from Plato's *Republic* to H. G. Wells's *Men Like Gods*, and in the last sentence we again linked up the matter of the two sections of the notes by stating that a material lost Atlantis was not likely to rise out of the waves again for the investigation of discoverers, but that an ideal Atlantis was gradually taking material shape in our midst.

What it all comes down to is that Mr. Mumford would have liked us to use the name *Atlantis* in its strict association with what was probably "an actual reminiscence (*amongst the ancients*) of a land submergence coeval with prehistoric man," whereas we used it in its less academic and more popularly accepted connotation.—ED.]

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